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ANALYSIS



BRITISH FERNS

AND THEIR ALLIES.

by

G. W. FRANCIS, F.L.S.

*Author of the Little English Flora, Grammar of Botany,
Dictionary of the Arts, Sciences, &c.*

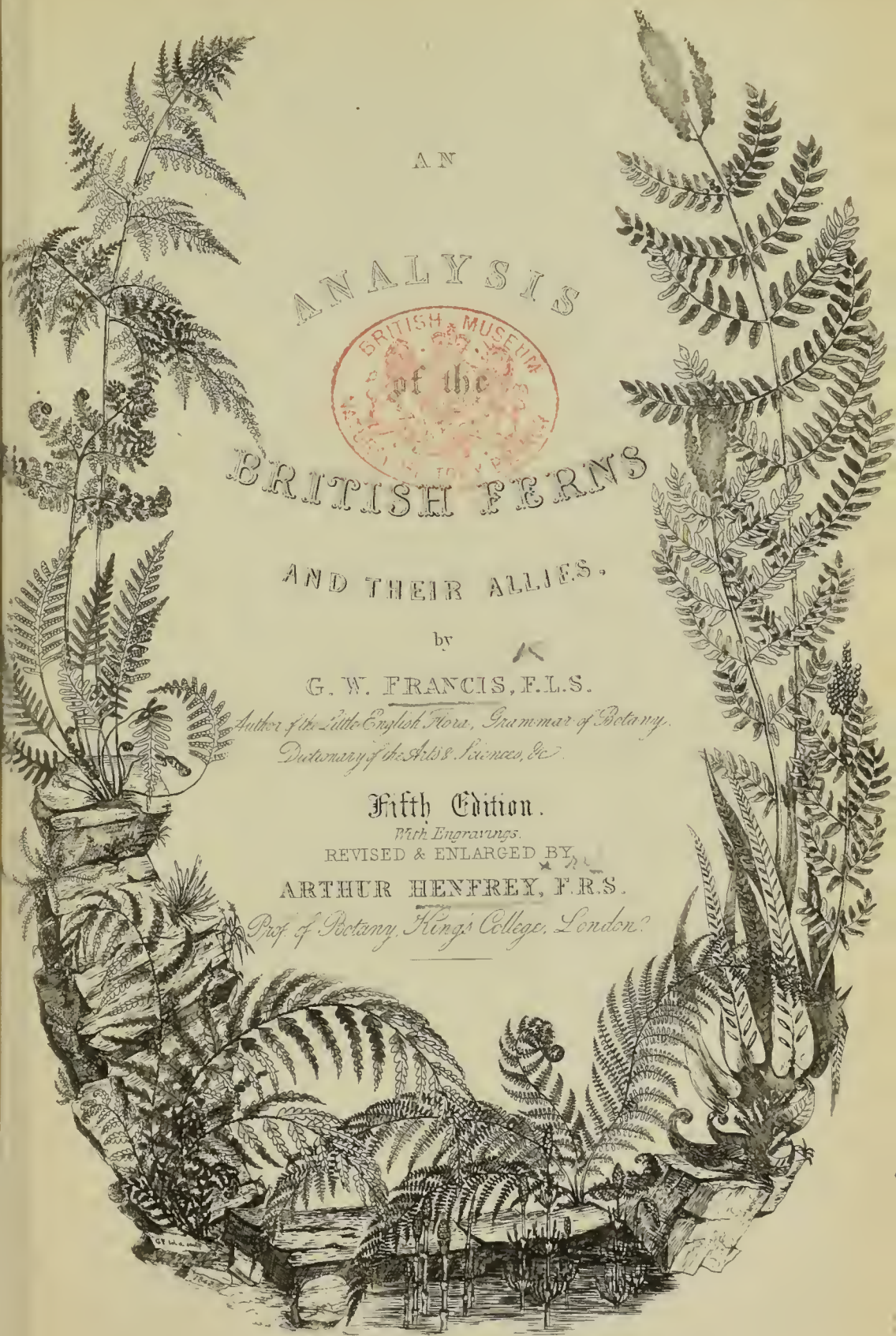
Fifth Edition.

With Engravings.

REVISED & ENLARGED BY

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TO
SIR WILLIAM JACKSON HOOKER, LL.D., F.R.A.I.S.
&c. &c. &c.

SIR,

To you, who stand so far before all other Writers in a practical knowledge of British Botany, and who have made the Ferns so particularly the subject of your attention, I beg respectfully to dedicate this little work. I am aware that it is too small to be worthy of your attention; but I am anxious to take as early an opportunity as possible of offering my homage to those brilliant talents which have contributed so essentially to diffuse a love of Botany, that energy without which even talents are unavailing, and that urbanity of manners and liberality of feeling for which Botanists have always been celebrated.

That you may long be spared the full enjoyment of all your mental and physical faculties, to cheer your friends and to instruct the world, is the ardent wish of,

Sir,

Your most obedient Servant,

THE AUTHOR.

PREFACE.

“ I acknowledge no authority but that of observation.”

LINN.

THIS motto was my governing principle in writing the following work on the ‘British Ferns and their Allies;’ and in adopting it I hope that I shall neither be accused of arrogance, neglect of the opinion of others, nor yet of unnecessarily varying the details of science. Should the reader ask, Why I write at all? I answer, because the only book ever published upon this subject (Bolton’s ‘*Filices Britannicæ*’), has long been out of print; and so much difference of opinion exists as to the identity of some species, and the arrangement of others, that I thought a plain and practical synopsis like the present would be useful to the tyro, if not to the practical botanist.

The materials from which it has been compiled are these:— I inspected all the herbaria to which I had access; gathered wild and cultivated fronds wherever I could procure them; and wrote to most of our first-rate botanists for specimens, remarks, and habitats. All these being collected, arranged, and studied, they were described and engraved without reference to any series of plates or descriptions whatever. I then collated these with the works of Linnæus, Willdenow, Sprengel, Swartz, Pursh, Withering, Smith, Hooker, Lightfoot, Hudson, &c. &c., and wherever there was a difference between myself and others I searched again for the truth; and if still in doubt, have been careful to record the disparity.

The long introductory matter explains all that is known of the internal structure, not only of the indigenous species, but of foreign also; and as it tends to induce in the mind a philosophical knowledge of the plants afterwards detailed, I flatter myself that the part

devoted to this will not be the least valuable to the student of nature.

The manner in which the object has been accomplished it is necessary to explain more fully. And, first, as to the illustrative plates—they are small, for the sake of economy, and are intended chiefly to indicate the habit of the plants, while the magnified parts show their detail. They might have been finer as works of art; but, had they been executed by an engraver, minute as they are, they would perhaps have been less botanically accurate, as the smallest variation in many of them would have materially altered their character; and, therefore, although a first and an untutored attempt at etching, I have preferred executing them myself, especially as by so doing I should save a large expense, perhaps not be refunded by the sale of the work. The engravings of genera are a new feature in illustration, and it is hoped a useful one.

In the record and detail of species the following order is observed: First, the Latin and English name, and reference to figure. Secondly, those essential characters which alone are necessary for discriminating the species, and which alone the true botanist will find it convenient to consult. The synonymes and references to figures in other works, which follow, give a history of the plant, and enable the student to refer elsewhere, if in doubt. The description may be considered collateral evidence, while the remaining parts will show him the varieties to which his plant is subject, the cause of them, its particular and general distribution, and the peculiarities attached to it.

In the part of the work which treats of the genera, the reader will find, first, the derivation of the genus, and a concise account of its general characteristics, and under it the arrangement of the species, according to their obvious distinctions.

In the essential characters of the different species, as few words as possible have been used, and those few pure and scientific. In the synonymes, which go back to the time of Linnæus (or in some few instances a little before), the names of authors only are given, unless they have called a plant by different names in different of their works, when the works themselves are also specified. In the descriptive part, and discriminating remarks which follow it, pure scientific detail has not been so much aimed at as obvious differences and popular

observations. The habitats have been collected from every authentic source which was attainable by me; a vast number will be found which have not been recorded before, and those few which are contained in previous publications have most of them been lately authenticated.

Information of this varied and local kind cannot, of course, be expected from any one's unassisted labours. I have therefore had recourse in the latter part to the assistance of friends, and I cannot speak too highly of the kindness and warmth with which my advances have been received, and without which indeed very much interesting matter must of necessity have been omitted. I hope that I have acknowledged in every instance the remarks thus received. My obligations are particularly due to H. C. Watson, Esq., who lent me the numerous lists, and manuscript localities, the results of his own observations, or communicated by botanical correspondents whilst he was preparing the 'New Botanist's Guide;' also for the valuable remarks of Mr. W. Wilson, Mr. W. Leighton, Dr. Murray, Rev. W. Bree, Mr. W. Pamplin, Mr. Bevis, and Mr. Castle.

And now, kind reader, I leave the work in your hands, concluding with the words of Linnæus to Haller: "If you have remarked errors in me, your superior wisdom must pardon them. Who errs not while perambulating the domains of Nature? Who can observe everything with accuracy? Correct me as a friend, and I as a friend will requite the kindness."

March 1, 1837.

THE above remarks formed the preface to the First Edition. The alterations introduced into the present are such as my own further study of this tribe, or the remarks of various kind friends have suggested. The plates have been all re-engraved, and of a larger size, consequently they are more numerous; and the plants, which it was almost impossible to express in the former very minute sketches, are more clearly defined. The general character of the plates is, however, similar; those of both editions having been drawn from, almost in every instance, the very same specimens. The woodcuts, now for the first time introduced, will, it is believed, be found useful. The Introduction contains much new and valuable matter on the

organic structure of certain species, which the laborious researches, and the acumen of Messrs. Henderson, Valentine, &c., have enabled me to avail myself of. Mr. H. C. Watson also has kindly contributed remarks of real interest on the geographical distribution of the various tribes; and Mr. Bevis, of the Royal Botanic Garden, supplied me with the groundwork of the Appendix, my own cultivation of the class having been very limited. The habitats have been arranged with more regard to latitude, but they have not been materially increased. That portion of the work devoted to scientific description has, no less than the other parts, been carefully corrected, yet the alterations will be found very few and unimportant.

My opinion of the identity and distinctness of certain species remains unaltered; yet I am aware that some writers differ from me, and would unite two of the Polypodiums—*Asplenium alternifolium*, and *Ruta muraria*, &c., founding their opinion upon specimens preserved in herbaria. I venture to protest against a too general reliance being placed upon this source of information; not but that reference to celebrated herbaria is most valuable, in addition to research; but this is all—a knowledge of plants can never be acquired by such means, because herbaria do not testify the circumstances of aspect, season, altitude, moisture, soil, and other influences, to which plants are subject. I make this remark chiefly in reference to the *Cysteas*, *Woodsias*, some of the *Aspidiums*, &c., about which botanists differ more than about any other genera. It is true that numerous fronds may be found of an intermediate character between two species; still, unless circumstances of growth be corresponding to all, this does not prove identity between the remote examples. This observation particularly applies to Ferns, because the diagnoses of the species rest mainly upon the shape of the frond, and this is the part which is alone subject to variation. The herbaria of even the most celebrated botanists are not always to be depended upon for accuracy. Plants are often received named—the name, without examination, is almost as frequently considered correct, and that specimen forms henceforth a criterion whereby to name others; thus error is continued and multiplied. To these causes I am inclined to attribute the contrariety of opinion which exists relative to our Ferns; and I may add, perhaps to our Willows, Roses, and Brambles.

It may, perhaps, be expected that I should have said something

relative to the new system of classifying Ferns according to their venation. I have not done so in the body of the work, because I do not find the system either correct, convenient, or practicable. For example, the veins of the British *Trichomanes* and *Hymenophyllum* are precisely similar, yet few would assign all these to the same genus. The veins of *Polypodium vulgare* and *Phlegopteris* are very different from each other, yet the plants are conveniently placed together. The veins of the latter plant resemble those of *Aspidium Oerolopteris*, yet I cannot consent to unite the two into one species. As to the veins of *Grammitis Ceterach*, Mr. Newman shows them as anastomosing; Mr. Presl as distinct and unattached at their extremities. Mr. Smith, Curator of Kew Gardens, who has paid much attention to the subject, says, "that neither of my figures, (which are copied, the one from Newman, the other from Presl,) is correct." And as to my own opinion, I confess I cannot make them out at all to my satisfaction, and that is the case generally with the coriaceous Ferns, particularly after having been dried for the herbarium.

June 1st, 1842.

A THIRD Edition of this work being now called for, I am sorry that I have it not in my power to offer any additional remarks upon the plants described. I would not have it inferred, however, that I consider my book either without error or complete, but merely that having been, since the issue of the second edition, resident on the Continent, and at all times much occupied, I have made no additions to my own stock of Fern knowledge; and moreover I never expected that a third edition would be called for, and therefore made no preparation for it.

I have to remark, however, that I have been blamed by one or two botanists for not discarding some of the present names, and adopting the more ancient, *Lastræa*, and other. I desire to pay the greatest deference to the opinions of others, and am most happy to learn from all, as to matters of fact, at all times; yet a change of names is always perplexing, and in this case unnecessary. I cannot

admit either that the amount of evil is very greatly less in reestablishing an obsolete nomenclature than in coining a new one. As to the mere intention assigned by some of restoring their due honour to ancient botanists, it is a principle good in theory, but which cannot be carried out; and would be of much injury to botany if it could: as we should be soon overwhelmed with terms now forgotten, and which are generally less appropriate and significant than the more modern appellations.

GEORGE FRANCIS, F.L.S.

July 1st, 1847.

THE demand for a Fifth Edition of this little work affords abundant evidence that it is well adapted to the purpose for which it was intended. I have consequently left untouched the names of the genera, in accordance with the author's views, and merely added those new synonymes which have made their appearance in other works since the Fourth Edition was published.

The principal alterations in this edition consist of the addition of several recently discovered species and varieties, and a more complete and accurate account of the reproduction of the Ferns and their Allies, in the Introduction, recent investigations having totally changed the formerly received notions on this subject. The technical terms have also been simplified and made more accurate, and a new plate has been added.

ARTHUR HENFREY.

London; Jan. 1855.

BRITISH FERNS.

INTRODUCTION.

A FERN is a flowerless plant which has a fibrous root, vascular stem, nerved leaves, reticulated epidermis furnished with stomata; and which bears spores as fruit in capsular receptacles.

The Ferns and their Allies form the first order of the Linnean class Cryptogamia, and the structure of them shows so exactly an intermediate character between the Phanerogamia and Cellulares, that all systems of classification have assigned them this station among vegetables. They are without flowers containing stamens and pistils and producing true seeds: they therefore cannot with propriety be arranged with Phænogamous plants; while their vascular texture and fully-developed leaves, borne upon a true stem, show their organization to be greatly above that of any other families of Cryptogamia.

Although the Tree Ferns have some analogy with the Cycadeæ in their habit of growth, the connexion between these and other orders is more apparent in the Pteroides or Fern Allies, particularly the Equisetaceæ and Lycopodiaceæ. The Equisetaceæ are nearly connected with several orders of Flowering plants. In their hollow, jointed, siliceous stems, they resemble the Grasses; in other respects, the Coniferæ and Amentaceæ, approaching the latter by means of the genus *Casuarina*, and the former by that of *Ephedra*; nor are they far removed in structure from the Charas; thus connecting also the Ferns and the Algæ. The Lycopodiaceæ were considered by the earlier botanists as Mosses, but they differ from that tribe, not only in habit, but in many important characteristics, especially in the fructification, which bears an analogy to that of the Coniferæ.

Thus the tribes under consideration, which are divided according to the modern system into FILICALES, EQUISETALES, and LYCOPODIALES—the first the true Ferns, the others the Pteroids or Fern Allies,—altogether form valuable, because well-connecting links in the great chain of nature.

The scientific division of the Ferns into tribes and orders was long a desideratum in botany. The earlier schemes are too vague for the present state of science. That of Willdenow, in which he depends upon external characters alone, is still, however, used; it divides the whole Ferns as follows:

1. GONOPTERIDES, which includes only the genus *Equisetum*.
2. STACHYOPTERIDES, including *Lycopodium*, *Botrychium*, and *Ophioglossum*.
3. SCHISMATOPTERIDES, containing only *Osmunda*.
4. FILICES, which comprises all the Dorsal and Marginal Ferns.
5. HYDROPTERIDES (Water Ferns), containing *Isoetes* and *Pilularia*.

Valuable as the system of Willdenow was, compared to all previously adopted, it is very far inferior to that of Sir J. E. Smith, improved as this has been by Mr. R. Brown, Kaulfuss, and others. Here, not only the external character of the fructification, but the structure of the fruit itself, and of its envelopes, is considered of importance as a guide to essential characters; while the shape, division, and habit of the plant, are used only in the discrimination of species: thus classifying the Ferns as much as possible by the same laws as those which govern higher orders of vegetation.

FILICALES.

Leaves never in whorls, with a greatly developed blade, which is usually much divided. The thecae at the back or on the margins of the leaves, or on the ribs of leaves where the parenchyma is suppressed. Spores of one kind.

* *With their capsules or thecae ringed.*

Thecae in clusters at the back of the leaf, bursting irregularly and transversely. Ring vertical, or a continuation of the footstalk of the theca. Stems solid; the veneration circinate. } POLYPODIACEÆ.

Thecae on columns contained in little cups on the margin of the leaf, bursting irregularly and vertically. Ring oblique. Veneration circinate. Stems solid. } HYMENOPHYLLACEÆ.

** *With an imperfect ring to their capsules.*

Thecae in clusters on the metamorphosed terminal pinna of a leaf, bursting at a longitudinal suture, two valved, transparent, stalked, striated. Veneration circinate. Stems solid. } OSMUNDACEÆ.

*** *Without a ring to their capsules.*

Thecae in spikes or racemes formed by the metamorphosis of a division of the leaf, bursting at a transverse suture, two valved, opaque, sessile, smooth. Veneration straight. Stems hollow. } OPHIOGLOSSACEÆ.

EQUISETALES.

Leaves represented by membranous scales, in whorls forming sheaths round the joints of the hollow, furrowed stems. Spores of one kind.

Thecae in terminal conical catkins. Spores bearing four elastic filaments. } EQUISETACEÆ.

LYCOPODIALES.

Leaves never in whorls, the blade moderately developed and never much divided. The thecæ axillary and sessile, or in stalked capsules. Spores of two kinds.

Thecæ indehiscent, inclosed within the base of radical leaves. Leaves hollow and filiform. Stem a corm or solid bulb. Vernation straight. (*Water plants.*) } ISOETACEÆ.

Thecæ axillary, on a leafy spike or stem, two to four valved, sessile, free, deliscent by a regular fissure. Stem solid, clothed with small overlapping leaves, creeping or upright. } LYCOPODIACEÆ.

Thecæ in coriaceous, stalked capsules near the base of radical leaves. Leaves (*Pilularia*) filiform. Stem long and creeping. Vernation circinate. } MARSILEACEÆ.

POLYPODIACEÆ.

(Including *Grammitis*, *Polypodium*, *Woodsia*, *Cystopteris*, *Aspidium*, *Asplenium*, *Scotopendrium*, *Blechnum*, *Pteris*, *Cryptogramma*, *Adiantum*.)

POLYPODIACEÆ, Br., D.C., Kaulf., Bory, Hook., Grev., Mack., &c.

FILICES VERÆ, Willd., Linn., Schreb., Juss.

FILICES ANNULATÆ, Hoffm.

FILICES GYRATÆ, Web., Mohr, Swtz.

FILICES DORSIFERÆ, Smith.

FILICALES, Lindl.

PTERIDALES, FILICALES PHYLLOPTERIDES, EPIPHYLLOSPERMÆ, &c. &c.

STRUCTURE.*—A FERN consists of stem, roots, leaves, and fructification. The rootstocks or subterranean stems, as well as the fibrils or true roots, are vulgarly included under the term root; while the word frond is often applied to the leaves, which generally constitute the only part above the ground, except the fruit and its appendages; the leaf is subdivided into rachis or petiole, or leaf-stalk, and pinnæ or leaflets, which latter are generally more or less compound, lobed, indented or divided into pinnules.

The ROOTSTOCK of all our native Ferns is perennial and fibrous. The fibres are stout, generally hairy or scaly. In many cases the fibres issue from a crown, and form a tuft of roots: in others, from thick stems, which in the British species creep under ground, sometimes to a considerable distance. These rootstocks, rhizomes, or creeping stems are furnished with buds, irregularly disposed upon their surface; the uppermost ones yielding leaves, while those below produce radical fibres.

The RACHIS or LEAF-STALK is sometimes smooth, at others scaly or hairy, sometimes wholly clothed with leaf-like expansions; at others void of them at the

* In illustration of the structure of all the tribes, the reader is referred to the illustrations of genera and their explanation. The stomata afterwards spoken of may very easily be seen in any under part of the epidermis, merely by tearing it off and submitting it to the microscope. The arrangement of the vessels in the stalk is apparent to the unassisted eye in any transverse section of it; and to view the spiral vessels it is only necessary to take two pins, and having thrust them through one of the bundles of vessels, separate them a little from each other, and in the cleft thus made the spirals will appear distinct when considerably magnified.

lower part. When cut transversely, it is seen to consist, first of an epidermis, then we find a hard, woody, green, brown, or black layer, the space within being filled with cellular tissue. Longitudinally through the tissue run bundles of vessels, most of which are true spiral vessels. Mixed with these vessels, which are real tracheæ, are tubular perforated ducts. The whole, thus compounded of the two sorts, is sometimes collected into a close bundle, but more generally into a cylindrical simons ring, either hollow or filled with cellular tissue, and surrounded by a layer of cells of dark brown colour. The number of these fascicles bears considerable relation to the size of the frond; thus, in *Pteris aquilina*, there are eight or ten; in *Aspidium aculeatum*, five; in *Polypodium vulgare*, three; while in the minuter species there is but one, which then occupies the centre of the rachis. When several bundles are present, no general rule can be given for their position (though constant in the same species), so varied are they in shape, size, and distance from each other.

The cellular substance appears to have no tendency to arrange itself in strata, nor do the vessels increase in number as the plant increases in age. The stems, therefore, contain no real wood; the nearest approach to it being the hardened epidermis and the ducts themselves. They increase very little in diameter, but grow longitudinally throughout their whole length.

The LEAF or FROND is in its leafy part thin, veiny, and green. The veins or ribs do not extend longitudinally through the leaf in any species, as in the Monocotyledones, but diverge in a forked form (dichotomously divided), from the base of the leaf, or from the midrib; differing, however, from those in Dicotyledonous plants in not containing woody fibre, and in being uniform in size throughout all their ramifications. The plan of division of the leaf is for the most part constant in the same species, but varied in the size and number of parts by external circumstances; the primary causes of which are superabundance or deficiency of nutriment, while temporary heat or moisture, exposure, shelter, or season of the year, occasion other but less striking irregularities. Even these causes have but little effect over numerous kinds, and very seldom in any case do they occasion so great an alteration of ordinary characters, as to throw doubt upon the species. (See *Cystopteris fragilis*.) The larger (primary) divisions of the blade are called pinnæ, the smaller pinnulæ or pinnules. The Ferns are several years in coming to maturity, before which their essential characters are not always obvious. Thus young plants of *Aspidium Filix-mas* very much resemble *Woodsia ilvensis*; they are first pinnatifid, then pinnate, afterwards, when perfect, nearly doubly pinnate. Also when a Fern has its barren fronds different from those which are fertile, the latter are more contracted, as if the sap which expanded the leaves of the one was employed in nourishing the fruit of the other.

The VERNATION. The circinate vernation, or curling up of the unexpanded leaves, which prevails in all the dorsal Ferns, is almost peculiar to this tribe and one of their allies, being found in only a few other orders; especially the Cycadeæ and the Droseraceæ. If the leaf be simple, so is the vernation, resembling a flat spiral spring; but when the leaf is subdivided, the vernation becomes equally

compound, the larger divisions first opening, and by degrees the pinnæ and pinnules.

The SCALES, so visible upon the stems and petioles of some species, have been regarded by some authors as leaves, the true leaf being then called a branch. The term *ramentum* is often applied to these scales which, with those found upon the divisions of the leaves, are probably mere appendages of the epidermis, like the hairs and scales found on the surface of the higher plants.

The EPIDERMIS of the expanded portion of the leaf presents a reticulated appearance (the meshes having wavy sides), and is furnished on the under surface with respiratory stomata, similar in form and function to those of Flowering Plants. On the number of these on a given space is in a great degree dependent the rapidity of the leaf's withering when gathered. They are very abundant in *Aspidium filix-fœmina*, *Aspidium dilatatum*, and *Polypodium Dryopteris*. Thus is explained the cause of the drooping habit of this last and some other species. Be it observed, however, that in *Grammitis Ceterach* and *Aspidium lobatum* they are still more numerous, yet these latter plants do not wither so soon, a circumstance that may easily be accounted for from the leaves of both being thicker, the deprivation of an equal quantity of water not producing so great an effect.

THE REPRODUCTION of Ferns has long been a subject involved in much obscurity. Hedwig, Bernhardt, and others, proposed theories to explain this intricate matter, but without success. That the Ferns have no visible flowers is evident; but that they had some apparatus analogons to stamens, was maintained by most of our first botanists. So keen has been the search for these in the present tribe, that every part of the plant has been subjected to the minutest investigation; not only the thecæ, their ring, and their cover, but the spiral vessels of the rachis, the stomata upon their epidermis, and the glands which are sometimes found attending upon them.

Sprengel long ago stated that the young sori, or rather that the swollen extremity of the veins, of *Polypodium vulgare*, which sometimes remain abortive, and at others produce thecæ, were filled with oblong-shaped bodies of a greyish colour, which he considered to be stamens, and as yielding pollen in the same manner as the external stamens of flowering plants. These being attended upon by young ovules, the latter became impregnated and grew to perfection, while the pollen masses decayed or were absorbed. This opinion was in a great degree and for a long time disregarded (perhaps because of his imperfect figures), and the grey bodies considered to be abortive capsules. The following remarks, however, from 'The Annals of Natural History,' given in the synopsis of a paper read before the Academy of Sciences at Berlin, March 1840, by Professor Link, drew a stronger interest to the subject:—"The part which Sprengel years ago indistinctly figured, and which Blume and Presl at present consider to be male organs of fructification, have been more accurately examined by Professor Link, and illustrated by drawings. They are long hollow filaments, separated by septa into articulations generally simple, rarely ramified; the last articulation is thicker,

and filled with a delicate granular mass. It may also at times be observed that this mass is exuded at the last articulation, and surrounds this as a crust. These parts are frequently longer than the capsules, and are easily distinguished from the young capsules." The late Professor Don, who wrote the above, adds—"It is certainly probable that they are the stamina of Ferns; and indeed Link found them, after frequent search, in most of the Ferns which he submitted to microscopical examination." [It is now known that they are merely abortive thecæ, the hair-like bodies called paraphyses.—A.H.] Mr. Henderson, in an interesting paper on 'The Germination of Ferns,'* denied that there was any impregnation in Ferns, Mosses, or Equiseta; yet, in an after paper read before the Linnean Society, on 'The Reproductive Organs of Equisetum,' he states that he had found two kinds of granules in the unripe thecæ of Ferns, Lycopodium, and Ophioglossum; that the one kind was mostly absorbed during the maturing of the other; and by submitting each to the test of iodine, he proved the one to be amylaceous or starchy, the other more of the nature of pollen. [These speculations were, however, all wide of the truth; recent researches have made us pretty well acquainted with the mode of reproduction of the Ferns and their Allies, and we know that we have not to seek for the representatives of stamens and pistils in the sori of the perfect plant, but upon the structures developed from the spores in germination. In following the order of the phases of growth of the Ferns, it is best to commence with the fruit of the parent plants.—A.H.]

THECA and SORUS. The spores in all the species are contained in capsules or thecæ, each of which opens by a transverse irregular fissure, and is furnished with a jointed ring nearly surrounding it (the annulus), by the elasticity of which the capsule is torn open and the spores dispersed (see figs. E and F in the woodcut illustrative of the genus *Grammitis*). The thecæ are collected into linear, oblong, or circular clusters, called sori, of which Professor Link thus writes:†—"The sorus is in general situated on a receptacle, which, when roundish, consists entirely of short spiral vessels, so called vermicoid bodies, similar to the thickened extremities of the leaf-nerves, which might therefore be regarded as abortive receptacles. In the elongated receptacles, spiral vessels are also met with." The sori are in some tribes of the Ferns naked (woodcut of *Polypodium*, figs. B and C), but in the generality covered with a scale or indusium, of shape similar to themselves (woodcut of *Aspidium*, fig. B). I remarked in the first edition, that the origin of this integument was undoubtedly similar to that of the scales, namely, disrupted epidermis. Microscopic observations, however, induce me to doubt this assigned origin for the indusia, and to consider them as distinct organs, as much so, indeed, as the calyx of a flowering plant, or the calyptra of a Moss. Whether they arise from the vermicoid bodies of Link, just spoken of, or not, I have been prevented from observing. These certainly attend the genus *Woodsia*, and are intermingled with the thecæ, the genus having no real indusium. In the genera *Cystopteris*, of *Aspidium*, *Adiantum*, *Pteris*,

* *Mag. of Zoology and Botany* vol. i, p. 340.

† *Ann. of Nat. History*, Aug. 1840.

&c., the reticulation of the indusium and epidermis is very different, and the former is not furnished with stomata. In many genera this organ may be supposed a part of the frond itself turned over upon the thecæ, as in *Adiantum* and *Pteris*, but I believe the reticulation is very distinct.*

[SPORES. When fertile leaves bearing ripe sori are shaken over a sheet of white paper, a fine brown or yellowish dust falls; this is composed of particles so small, as to be invisible singly to the naked eye. These particles are the spores of the Ferns, which, when sown, grow up into new plants, like the seeds of the Flowering Plants. They retain the power of germinating for a long period, even when dried and preserved in herbaria. They differ importantly from true seeds in many respects, the chief of which is the absence of an embryo or rudimentary plant in their interior. In their structure they agree almost exactly with the pollen-grains of Flowering Plants. When examined with a microscope, they are seen to be roundish, angular, or oval bodies, sometimes with a smooth surface, but very often presenting little tubercles, lines, or reticulated ridges upon the outside. Close investigation shows that the outer coat is lined by another, thinner and smoother one, the two together forming a kind of little bag or sac (called by botanists a *cell*), containing merely a thickish granular liquid.

GERMINATION of the SPORES. When these spores are sown upon a moist surface, they, after a certain period, germinate. The first sign of this operation is a bursting of the outer coat, and the protrusion of the inner in the form of a little tubular pouch. The contents of this pouch soon acquire a green colour, the tube becomes divided by cross partitions as it elongates, and, finally, the end first protruded from the spore enlarges in size, by the formation of cells, until it appears as a little, leaf-like, green plate, somewhat of the form of the heart on playing-cards, only much broader in proportion to its length, and with a deeper notch. The end of the tube which at first lay within the spore gradually withers; but the point of the heart-shaped plate, corresponding to this end, becomes thickened, and sends out a quantity of hair-like radical filaments. Leaf-like bodies such as are here described are commonly to be met with under Ferns which have borne fruit, in Ward's cases, or in pots kept in a moist atmosphere. They look like patches of some small Liver-wort, and have a glistening surface like many of these.

So far there is nothing very remarkable in the development of these plants from their spores; but the succeeding phenomena are exceedingly curious, and of a kind only met with in the Ferns and the Allied families. The merit of the discovery of the analogies between the reproduction of the Ferns and that of Flowering Plants is undoubtedly due to the Count Suminski, in whose work upon this subject, published in 1848,† the pistillidia of the Ferns were first described, and the nature of the antheridia, previously seen by Nägeli, first correctly interpreted. The details of the structure and the course of development were not accurately

* The indusium is certainly related to the epidermis, and no true organ. The difference of reticulation is nothing, hairs and scales deviate much from the forms of the surrounding cells of the epidermis.—A.H.

† *Entwicklungsgeschichte der Farrenkräuter*; Berlin, 1848.

given by Suminski, but these have been since made out, and the existence of sexes in the Ferns placed beyond a doubt. Thus the supposed hybrid forms which had been frequently observed among cultivated Ferns, are no longer anomalous or inexplicable. It will be unnecessary to enter very minutely here into the phenomena now in question, or into the history of their elucidation; a full account of these points will be found in the 'Transactions of the Linnean Society.'* The main particulars are as follows:—At an early period of the expanding growth of the leaf-like product of the spore (called the prothallium, or germ-frond), a number of little cellular bodies are found, projecting from the lower surface, which, if placed in water when ripe, burst and discharge a quantity of microscopic filaments, curled like a cork-screw, and furnished with vibrating hair-like appendages (cilia), by the motion of which they are actively propelled through the water. The cellular bodies from which these are discharged, are called the antheridia of the Ferns, and are, in their physiological nature, the representatives of the pollen of the Flowering Plants. At a somewhat later period, other cellular bodies, of larger size and more complex structure, are found, in small number, about the central part of the lower surface of the prothallium, on the thickened portion situated between the notch and the part where the radical filaments arise. These, the pistillidia or archegonia of the Ferns, are analogous to the ovules or nascent seeds of the Flowering Plants, and contain, like them, a germinal vesicle, which becomes fertilized through the agency of the spiral filaments mentioned above, and is then gradually developed into an embryo plant possessing a terminal bud. This bud at once begins to unfold, and push out leaves with a circinate vernation, which are of very simple form at first, and rise up to view from beneath the prothallium, coming out at the notch; single fibrous roots are at the same time sent down into the earth, the delicate, expanded prothallium withers away, and the foundation of the perfect Fern-plant is laid (see fig. H in the woodcut illustrative of the genus *Asplenium*). As the bud unfolds new leaves, the rootstock gradually acquires size and strength, and the leaves become larger and more fully developed; but it is a long time before they assume the complete form characteristic of the species.—A.H.]

NUMBER AND DISTRIBUTION.—For the following remarks upon this subject I am indebted to H. C. Watson, Esq., than whom no botanist has more studied the subject. He says, "Dorsiferous Ferns are found in every part of Britain, except on the summits of the loftier mountains, and in small spaces of the lower grounds, whence they are banished by local peculiarities of the soil or surface. But overlooking these merely local exceptions, of trifling extent, Polypodiaceæ may be stated to range over the whole of Britain, from south to north, from east to west, and from the shores of the sea almost to the summits of the highest hills; in which latter situation their absence is to be attributed rather to the bleak exposure than to the absolute height. The number of our dorsiferous Ferns will be estimated variously, according to the views entertained with respect

* Henfrey on the Development of Ferns from their Spores. *Lin. Transactions*, vol. xxi, p. 117.

to union or division of reputed species, but 35 is the number most generally received. These bear a proportion to flowering plants (reckoning the latter at 1400) of 1 to 40. The order has a great numerical predominance over the other orders of Filicales, &c., all taken together; the proportion of its species being to those of the other three orders, as 6 to 1. And since the most abundant and widely-ranging species of Ferns are also to be found amongst the Polypodiaceæ, the effect of this order in the general vegetation of our island much exceeds that of the allied orders of Ferns. Of the six species referred to other orders, one is exclusively an inhabitant of Yorkshire (if it really be there still); namely, *Trichomanes brevisetum*; a second, *Hymenophyllum Tunbrigense*, is local; a third, *H. Wilsoni*, though much more plentiful, is limited to the northern and western counties; whilst the other three, the *Osmunda*, *Botrychium*, and *Ophioglossum*, though widely scattered through Britain, are by no means so generally present as many of the Polypodiaceæ. Several of the British dorsiferous Ferns are so widely and plentifully scattered throughout the island, that there can be no doubt about their existence in every county of Britain; although published records will not enable any one to make the assertion on evidence. Others, on the contrary, are much more limited in their range, being absent from the southern, or northern, or lowland counties of England. Only a few species can be called decidedly rare. The mountain valleys below 1500 or 2000 feet are the head quarters of Polypodiaceæ; very few species wholly shunning the mountain tracts, and a still less number being exclusively confined to the higher parts of the hills. The specimens are numerous amongst the mountain valleys, in the western countries, and in the vicinity of the coast. On the contrary, they are few in marshes, on low plains, dry moors, exposed downs, and places destitute of woods or other shelter from sun and wind. Apparent exceptions to the favorable or unfavorable effects of any of these conditions, may usually be explained by excess in some other and counteracting one. Thus, the salt spray and violent winds of the western shores are highly unfavorable to the growth of most Ferns, though otherwise their humidity of atmosphere would be favorable; and accordingly whilst the exposed shores and cliffs may be almost without Ferns, caves and sheltered ravines in their immediate vicinity may be numerously tenanted. For the most part, however, even situations that are unsuitable to the majority of Ferns, have their own appropriate species. Thus, *Asplenium marinum* flourishes on cliffs exposed to the sea; *Pteris aquilina* and *Blechnum* often grow on the unsheltered heaths, in places open to sun and wind; *Asplenium rutamuraria* and *As. Adiantum nigrum* live in the crevices of dry walls and rocks. There are, however, no aquatic Ferns, and scarcely any of the Polypodiaceæ, that can be designated marsh plants; unless that occupant of swampy bogs, *Aspidium thelypteris*, be called a tenant of the marshes. A light friable soil, and more especially that formed by the decay of tree leaves, mosses, or other vegetables, is suitable to the roots of most Ferns; but some delight in limestones soils as *Grammitis ceterach*, *Polypodium calcareum*, and *Cystopteris fragilis*; whilst the *Asplenium septentrionale* and *Woodsia ilvensis* seem to affect the basaltic trap

and the harder primary rocks. The operations of human industry have greatly interfered with the natural distribution of Ferns in this country. They have been banished from our roads, corn fields, meadows, and artificial pastures; and the cutting of peat, and burning of heath and furze, often check the growth of species fitted to thrive in places where these operations are performed. On the other hand, our hedge-banks, loose stone fences, old buildings, and neglected quarries, frequently become artificial Filicetums, by affording suitable habitats for several species. These remarks on the distribution of Polypodiaceæ will be understood to apply to the island of Great Britain only. Ireland has twenty-six species of dorsiferous Ferns; but of their range and distribution within that island little is known. All those of Ireland are natives also of England.*

VIRTUES.—The uses of the Ferns are not very conspicuous. Their bitter principle renders them unpalatable to all creatures. Neither men nor brutes employ any species as an article of food, unless driven by the necessity of hunger;† and even the little insects that infest herbaria refuse to prey upon them. They are not, however, wholly useless, either in medicine or the arts. The powdered rootstocks of some of them are efficacious in expelling intestinal worms; some of them have been used as a substitute for hops in brewing, and with better success than most other plants, on account of the tannin and gallic acid they contain precipitating the feculent matter in the wort. The same constituent principles render them also serviceable in preparing kid and other light leathers, and when burnt they yield much comparatively pure potass. The dried fronds of the common brakes are valuable to pack fruit in, and as they retain moisture less, are much better than straw to shield garden plants from frost. Except for these uses, the Ferns have been but little employed, unless, indeed, for those purposes to which most plants when dry are available, namely, for litter, thatch, fodder, and for fuel.‡

HYMENOPHYLLACEÆ.

(Containing the Genera *Hymenophyllum* and *Trichomanes*.)

TRICHOMANOIDEÆ, *Kaulf.*

FILICES DESCISCENTES, *Spreng.*

PART OF GYRATE, ANNULATÆ, POLYPODIACEÆ, GLEICHENIACEÆ,

FILICES VERÆ, HYMENOPHYLLÆ, &c. of *Authors.*

* A very interesting and extended paper upon the distribution of our Ferns, by Mr. Watson, will be found in 'The Transactions of the Edinburgh Botanical Society,' Part II. The above remarks, together with others of a corresponding character, inserted at other places, were kindly contributed to the Author, in writing, some time since. They may not agree, therefore, in precise words with the Edinburgh paper.

† Professor Henslow was kind enough to point out to me some time since that I had forgotten the circumstance of the New Zealanders living mainly upon Fern roots. It is true that they do so; still Ferns are a sorry food, and now that the colonists have taught the natives the art of cultivation, Fern roots are becoming less and less an article of consumption. That hunger alone induced the islanders to use these roots as food, may be inferred from the circumstance, that they were ready enough to work for the first settlers merely to be supplied with the commonest European grain or pulse, though the Fern grew abundantly on every side, and might have been procured and prepared comparatively without labour or expense.

‡ For the proper and modern culture of the Ferns, see the Appendix.

STRUCTURE.—The plants contained in this order long maintained a situation among the dorsal Ferns, though improperly, because their fruit is not dorsal but marginal, growing in a distinct and differently organized receptacle. The annulus corresponds in its functions, jointed appearance, and elasticity, to those of the last order, except that instead of its being a continuation of the stalk of the theca, it is placed obliquely or transversely (woodcut of *Trichomanes*, fig. E), and consequently the theca bursts vertically. For this reason, *Hymenophyllum* and *Trichomanes* form an order separate from the *Polypodiaceæ*. Besides the difference in the fruit, the texture of the leaves is much simpler than in the last order. The leaf-stalk of each native genus is quite smooth and round, and contains but one bundle of spiral vessels; this is solid, and forms an axis. The thecæ arise from the veins still more evidently than even in the preceding order, as the receptacle is in the place of a lobe of the leaf. The laminae of the lobe contracted form the valves of the receptacle, and its vein or nerve exists as a central column, upon which the thecæ are seated; in *Hymenophyllum* the vein terminates within the receptacle (woodcut of *Hymenophyllum*, fig. C), in *Trichomanes* it is prolonged much beyond (woodcut of *Trichomanes*, figs. A and B). The rootstock of *Trichomanes* is thick, black, and very hairy; that of *Hymenophyllum* very long, creeping, and matted together.

DISTRIBUTION.—“*Hymenophyllaceæ*, more impatient of drought than many of the *Polypodiaceæ*, delight in shaded situations, where they are bedewed by frequent mists and the spray of waterfalls; growing on damp rocks and stones, half buried amongst the Mosses that accompany them; and like the Mosses rapidly shrinking or expanding with variations of moisture. Two of the three native species are rare in Britain, especially the *Trichomanes*, which is peculiar to Yorkshire, if it be not now extinct in England. Another, *Hymenophyllum Tunbridgense*, is found in various counties of England and Scotland, varying from Devon and Sussex to the river Clyde in Scotland. The much more abundant *H. Wilsoni*, was so long confounded with the former species, that it has been supposed a rarer plant than it really is, for the greater number of localities assigned for *H. Tunbridgense* belong to *H. Wilsoni*. This latter species ranges from Cornwall, northward, to Sutherland, and rises on the mountains of Wales nearly to 2000 feet, and not improbably more.”—*Mr. Watson's MS.*

OSMUNDACEÆ.

(Contains only the genus *Osmunda*.)

OSMUNDACEÆ, *Br., Kaulf., Lind., Hook., Agard.*

OSMUNDEÆ, *Spreng.*

SCHISMATOPTERIDES, *Willd.*

SPURLE GYRATE, *Sic.*

RIMATE, *Mohr.*

ACROGYRATE, *Bernh.*

EXANNULATE of *Modern Authors.*

STRUCTURE.—This order varies very little from the two former, except

in the fructification. The rachis is similar in vernation and structure—the mixed vessels are arranged in the indigenous species in part of a circle like the letter ©. The epidermis of the stem is void of stomata, but on the under surface of the foliaceous part of the frond they are round, abundant, and very large. In the fruit, a great difference exists between this and the Annulate Ferns. The thecæ are transparent and wrinkled, and have only an obscure indication of an annulus; they are not torn asunder irregularly, but open by a distinct longitudinal fissure, and are thus regularly two-valved (woodcut of *Osmunda*, fig. D). They are not fixed at the back of properly developed leaflets, but densely clustered at the top into a large erect raceme, the divisions of which correspond to those of the leafy portion, indicating that the raceme is formed of metamorphosed pinnæ (woodcut of *Osmunda*, fig. A). The leaflets of the upper part of the frond are also often partly changed into thecæ of similar character, thus proving the origin of the whole. (See *Osmunda*.) In *Todea*, an exotic genus, the thecæ are borne on unaltered pinnules, as in the *Polypodiaceæ*.

DISTRIBUTION.—“Here the distribution of an order in that of a single species only, the *Osmunda regalis*, which prevails chiefly in the south-west of England, and perhaps the south-west of the Highland tract; being very frequent on the coasts of Cornwall, and occurring in plenty about some of the lochs of Argyleshire, and on adjacent islands. The range of the *Osmunda* extends the whole length and breadth of Britain; but whether it be found on the islets north of Sutherland, or west of Islay, is yet unknown. Still, there are considerable tracts along the eastern side of England and Scotland, where it is either extremely scarce or wholly wanting. The *Osmunda* differs from most of the dorsiferous Ferns in being adapted to thrive in marshy places, and to flourish on the sea shores, sometimes only just above high-water line. Notwithstanding that it endures the boreal climate of Sutherland (a county in which the specimens are said to be small), the *Osmunda* is perhaps never seen much above the sea level in England, although the general vegetation of the coast in Sutherland approximates closely to what is observed at 1000 or 1200 feet of elevation in England. In respect to frequency of occurrence, the *Osmunda* may rank nearly on the level of its allies, the *Botrychium* and *Ophioglossum*, though rather less frequent than either of these.”—*Mr. Watson's MS.*

OPHIOGLOSSACEÆ.

(Contains *Botrychium* and *Ophioglossum*.)

OPHIOGLOSSACEÆ, *Br., Lind., &c.*

OPHIOGLOSSÆ, *Spreng.*

FILICES, *Linn., Smith., Hook., &c.*

STACHIOPTERIDES, *Wittl.*

BIVALVA, *Hoffm.*

VALVATÆ, *Web., Mohr.*

AGYRATÆ, *Swz.*

STRUCTURE.—The plants contained in this order differ very materially from

all other Ferns. Their rootstock is smooth, fibrous, and yellow, not creeping nor hairy: and gives rise to one or but a few leaves only, which issue from the ground with a straight and not circinate vernation. In *Botrychium* the bud for the succeeding year is enclosed in the leaf-stalk of the older leaf, just as is the case in the Plane-tree. The leaf divides half way up into two portions, a barren and a fertile. The former expands into a blade, either simple (*Ophioglossum*) or compound (*Botrychium*), while the latter forms a kind of spike (*Ophioglossum*) or raceme (*Botrychium*), consisting of the main veins of the petiole clothed with sessile thecae, which are two-valved and quite destitute of an annulus. (See the woodcuts to these genera.) The thecae open by a regular transverse fissure, emitting smooth, yellow, very minute seeds; those of *Botrychium* in twos or threes. The rootstocks of both genera are perennial, the leaf-stalks herbaceous and hollow. The leaf-stalk of *Botrychium* has its ducts in two bundles near the centre; that of *Ophioglossum* in from five to seven bundles; seated between two cylindrical layers, and by their pressure forcing the inner one into a tortuous form.

DISTRIBUTION.—“The two plants comprehended in this small order differ from most of the Polypodiaceæ, by growing chiefly in more open situations; their upright habit perhaps rendering them less adapted to banks and rocks. Both range widely through Britain, and are about equally frequent, holding an intermediate place between the rare and the common plants. The *Ophioglossum* prevails chiefly in England, decreasing in frequency northward. The *Botrychium*, on the contrary, is abundant on the hills and moors of the north, and becomes a rare plant in the south, and especially in the south-east of England. *Ophioglossum* ranges from the south of England, as Devon and Sussex, northward at least to Moray; and, if we may reply upon Barry’s ‘History of Orkney,’ to those islands also. The *Botrychium* is scarce on the south side of the Thames and Bristol Channel, but is stated to grow in North Devon and in Hampshire, though not introduced into the Flora of the former county. The stations in the south of England of course indicate that both species will grow at a low elevation, and remote from the mountain tract, even in the warmest part of Britain; and both also thrive amidst the mountains in the north of England and Scotland; but the *Botrychium* probably rises to a much greater height on the hills, as it occurs on the Breadalbane mountains, near Killin, at the estimated height of 1000 yards, whilst no very high elevation for the *Ophioglossum* appears on record. Of the two, the *Botrychium* is the least frequent, or seems to be so on account of its more boreal and Alpine tastes.”—*Mr. Watson’s MS.*

EQUISETACEÆ.

(Comprises only *Equisetum*.)

EQUISETACEÆ, *Decan. Ag., Kaulf., Lind., Hook., Grev., Brong.*
 GONOPTERIDES, *Willd.*
 PART OF FILICES, MISCELLANÆÆ, &c., *of Authors.*

[CLASS.—These plants differ widely from all those hitherto described, and in some respects approach very much nearer to Flowering plants than the Ferns do. The structure of their spikes of fructification bears a strong resemblance to that of the male cones of some of the Coniferæ, but these produce, not pollen, but spores, the germination of which is essentially like that of the Ferns, resulting in the formation of prothallia bearing similar sexual organs. But the peculiar habit of *Equisetum*, which may be contrasted with the Ferns as consisting chiefly of *stem*, while the latter are almost all leaf, separates it clearly from them as a distinct family, while it differs still more importantly from the other Fern Allies.

STRUCTURE (see woodcut illustrating the genus).—The erect stems, which arise from jointed rootstocks creeping beneath the surface of the ground, are, when young, filled with very loose cellular tissue: the moisture of this soon drying up, they become hollow. They are set at intervals with joints, surrounded by toothed sheaths (A), are regularly channeled or striated, and either simple or furnished with whorls of branches at the joints, of similar character to the main stem (B). The teeth of the sheaths are rudimentary leaves. A transverse section of the hollow stem shows that between the outer and inner surfaces is a circle (and in *Equisetum fluviatile* two circles, alternating with each other), of large air-tubes, distinct from each other but terminating at every joint of the stem, fresh tubes of a similar character being found at every other joint (see woodcut, fig. J). Around these tubes, and especially towards the outside of the whole stem, and immediately under the epidermis, are the vessels of the plant, usually what are called annular or ringed vessels or ducts. The epidermis of these plants has a larger quantity of silica deposited on it, giving it great rigidity and a rough surface; the inner surface of the stem is frequently more siliceous than the outer, forming a very beautiful object even to the naked eye. So abundant is this deposit in *Equisetum hyemale*, that, after the vegetable matter has been removed by maceration, the silica has been sufficiently abundant to retain the form of the plant; and in general the form of the epidermal cells and the stomates may be perceived in specimens from which the vegetable matter has been carefully burnt off, when these are submitted to the microscope.—A. II.] The stomates are arranged in longitudinal rows, a pair on each channel. M. John, of Berlin, states that the stems contain full 13 per cent. of silica. The following interesting particulars of the siliceous epidermis of *Equisetum* is given in Dr. Greville's excellent '*Flora Edinensis*,' p. 214: "On subjecting a portion of the cuticle to the analysis of polarized light, under a high magnifying power, Dr. Brewster detected a beautiful arrangement of the siliceous particles, which are distributed in two lines parallel to the axis of the stem, and extending over the whole surface. The greater number of the particles form simple straight lines, but the rest are grouped into oval forms, connected together like the jewels of a necklace, by a chain of particles forming a sort of curvilinear quadrangle; these rows of oval combinations being arranged in pairs. (These are seemingly the stomates.) Many of those particles which form the straight lines do not exceed the 500th part of an inch in diameter. Dr. Brewster also observed the remarkable fact, that each particle has a regular

axis of double refraction. In the straw and chaff of wheat, barley, oats, and rye he noticed analogous phenomena, but the particles were arranged in a different manner, and 'displayed figures of singular beauty.' From these data, the learned doctor concludes, 'that the crystalline portions of the silex, and other earths which are found in vegetable films, are not foreign substances of accidental occurrence, but are integral parts of the plant itself, and probably perform some important function in the processes of vegetable life.'—*Brewster MS.*

THECÆ AND SPORES. The spores are produced in a terminal spike or catkin (A), composed of hexagonal shields (c), from the under side of which depend hollow, scale-like thecæ (c, d), opening inwardly, and emitting green, ovate spores, to each of which is attached four club-shaped filaments. When the spores are immature, the filaments are twisted tightly round them; but when ripe, they become exceedingly elastic and hygrometrical, so much so, that the irritability occasioned by a change of temperature or moisture, causes the spores first to burst the thecæ which bear them, and afterwards to scatter themselves to a considerable distance (e, f, g).

A valuable paper upon the formation of the spores, by Mr. Henderson, was read before the Linnean Society, in June 1840, and will be found in their 'Transactions,' vol. xviii, p. 567. The experiments of this gentleman exactly confirm the above view, and give also the origin of the minute grains found upon the elaters or elastic filaments; from this paper, it appears that when the integument of the spore shows the spiral lines, which it will afterwards break into the elaters, it contains a greenish-coloured fluid, mixed with some minute granules. The spores then become darker, the granules increase, the liquid is absorbed, leaving the granules which it contained sticking in masses to the spores, and to the separated portions of the integument. These masses of granules, were found adhering to the filaments in the ripened state of the spore, taken by him for pollen-grains, but this has proved to be erroneous.

[GERMINATION OF THE SPORES.] From the observations that recently have been made, it appears that the spores of the *Equiseta* do not long preserve their germinative power, but must be sown when fresh from the thecæ. They seem to require much moisture and go through their early stages well if scattered on the surface of water. The spores germinate much in the same way as those of the *Ferns*, protruding a tubular pouch, which elongates, or expands at its end into a minute leaf-like prothallium. Upon these prothallia antheridia and archegonia are produced; but in *E. arvense*, *pratense*, and *palustre*, and perhaps in the other species, the prothallia are dioecious, each producing either only antheridia or only archegonia. No difference can be detected in the spores which produce the different sexes. The male prothallia are smaller than the female, usually of a yellower tint, and bear numerous antheridia, which are situated at the margins. The female prothallia are ordinarily much rarer than the male, but this, perhaps, depends upon external conditions; they bear the archegonia upon distinct lobes, and there are often more of them than of antheridia on the male plants (20—30); and they come to full development later than the male ones sown at the

same time, and in a healthy condition form circular patches, a quarter to half an inch in diameter, composed of four or six vivid green lobes, looking like a patch of young Liverworts. The archegonia are produced on the front margins of the lobes of the prothallium, but by the thickening of the tissue beneath soon appear to be upon the upper surface. They essentially resemble those of the Ferns, and are in like manner fertilized by active ciliated spiral filaments discharged from the antheridia; here, however, often five or six are fertilized on the same prothallium. The germinal vesicles in the interior of the archegonia then at once commence their development, and break forth as rudimentary stems with imperfect sheaths (representing the leaves) and root-fibres. The first bud at the top of the young plant is usually little developed, but lateral buds arise in the axils of the sheath-scales, which form horizontal branches, and thus produce the ramified subterraneous rootstock characteristic of these plants. The sheaths of the young stems have very few teeth, and these increase in number as the stems gather strength and acquire larger dimensions (similar to the gradual acquisition of the true form of the leaf in the Ferns). The development of the Equiseta from their spores takes place very rapidly; those of *E. variegatum* sown in the beginning of May produced leafy plants upon the female prothallia by the middle of July.*—A. H.]

DISTRIBUTION.—“Nearly equal in number with the Lycopodiaceæ, the plants included under this order contrast against them in their distribution. Whilst the former are described in general terms as plants of the moors and mountains, the Equisetaceæ belong more especially to marshes, fields, and woods. Both orders, or genera, are alike widely distributed through Britain; but whilst the Lycopodiums prevail high on the mountains, the Equisetums are more abundantly bestowed upon the lower grounds, or the plains and valleys; the latter also evince more of a maritime, or even littoral tendency than the Lycopodiums, being often seen in abundance on and near the sea-shore.”—*Mr. Watson's MS.*

USES.—They are harmless to cattle, but refused on account of their husky, rigid texture. They are useless as medicines, but employed in the arts; their siliceous cuticle rendering them valuable as polishing substances for marble, wood, ivory, and even metals.

ISOETACEÆ.

(Containing *Isoetes* only.)

LYCOPODIACEÆ, *Lind., Decan., Brongn.*

MARSILEACEÆ, *Hook.*

MISCELLANÆ, PART OF RHIZOSPERMÆ, RHIZOPTERIDES,
HYDROPTERIDES, &c.

STRUCTURE.—The genus *Isoetes* (see the woodcut illustrating this genus) has

* More minute details may be found in the following memoirs (in German): Milde, ‘Ueber Equiseten,’ *Linnaea*, 1850; W. Hofmeister, ‘Vergleichende Untersuchungen höheren Kryptogamen,’ *Leipsig*, 1851; and ‘Beiträge zur Kenntniss der Gefärskryptogamen’ (Trans. of the Royal Society of Saxony, vol. iv).—A. H.

in all arrangements of British plants been associated with *Pilularia*, on account of their both being water plants, both having round and filiform leaves, and bearing two kinds of grains or capsules; but, except in these particulars, they are totally different from each other, and *Isoetes* is really more closely related to the *Lycopodiaceæ*. [The roots of *Isoetes* are tufted, composed of round, smooth branched fibres; its leaves grow from the crown of a bulb-like, perennial stem, which increases in size by annual layers of fibro-vascular structure. The roots emerge from this, below, like those of bulbs and corms, but have this peculiarity, that the outermost are the oldest, the new ones springing from the centre like the leaves in a bud.—A. H.] The leaves consist of four hollow tubes, united together, but so brittle are they, that the cells are often broken into each other by the pressure used in drying the plants, and therefore the leaf generally appears like a single tube, divided into cells by transverse dissepiments. It is expanded at the base so that the joint or cell next the stem becomes a receptacle for the fruit, which is of two kinds; one minute, like pollen-grains, in the inner leaves—the other, much larger, confined to those on the outside of the plant. [These relative positions arise from a kind of periodicity in the growth.—A. H.] The spores are set free by the decay of the walls of the receptacles. The leaves are said to have stomata, and to be eireinate in veneration, but neither of these is the case. Being a submerged water plant, of course it is without stomata, and Martius expressly says, “veneration not eireinate, but only a little bent.” An observation confirmed to me by four or five botanists of eminence.

[SPORES AND GERMINATION. As in the Ferns and their other Allies, the mode of reproduction of *Isoetes* has only been cleared up recently. The smaller spores do not differ importantly from those of the Ferns; they are rather smooth, and of the shape of a quarter of a globe, and resemble pollen-grains in structure. The larger spores, which are produced in smaller numbers, are especially distinguished by their size, the globular form when mature, the firm outer coat composed of three layers of membrane, and the presence of three elevated ridges radiating from a point upon the external surface.

When these spores are discharged from the sporanges, they undergo very dissimilar courses of development. The small spores, after about a month, burst, and set free two or four minute vesicles which have been formed in their interior; these, again, give birth to one or two lenticular vesicles, from each of which escapes a ciliated spiral filament, such as we have described in the preceding families.

The large spores contain only oily and mucilaginous matter when first set free. If examined by the microscope in a few weeks after, they are found to be filled up by cellular tissue. The external firm coat is then soon ruptured, in the lines of the three convergent projecting ridges, so that three triangular free teeth are formed, which turn back and leave a small portion of the internal cellular tissue bare. Upon this bare portion, at first in the centre, exactly under the point where the three ridges met, an archegonium is formed, exceedingly small in size, but essentially resembling those of the Ferns and *Equisetaceæ*. If the first is not fertilized, others are produced, and as many as eight have been observed. A

germinal vesicle contained in the archegonium is fertilized by the active filaments developed from the small spores, to become developed into a leafy plant like the parent, quickly breaking out at the top of the large spore, and sending a leaf-bud upwards, and roots downwards. When these have acquired a certain size the remains of the large spore and its contents wither away, but while they remain the little plant much resembles a germinating Monocotyledon.*—A. H.]

DISTRIBUTION.—“The single species of this order, a submerged aquatic, can of course grow only where there is a suitable home in the waters. Probably it may require also that the water be of low temperature in summer, since most of its habitats are the Highland lakes; although, according to Mr. Griffith, it extends southward into Shropshire. There are very few other English and Welsh counties that produce it, and these few are all mountainous; namely, Caernarvonshire, Denbighshire, Cumberland, and Northumberland. In most counties north of the Firths of Forth and Clyde, we may find it in the lakes, some of them being situate 600 yards or upwards above the sea.”—*Mr. Watson's MS.*

LYCOPODIACEÆ.

(Comprises only *Lycopodium*.)

LYCOPODIACEÆ, *Br., Deean., Hook., Lindl., Burn.*

LYCOPODINEÆ, *Swz.*

LYCOPODEÆ, *Spreng.*

BIVALVA, *Hoffm.*

VALVATÆ, *Web., Mohr.*

STACHIOPTERIDES, *Willd.*

[STRUCTURE.—The Lycopodia resemble certain of the Mosses in habit, the Ferns in vascular structure and foliaceous texture, and the Isoetaceæ in fruit. The stems are slender, branched by forking, leafy throughout their whole extent, not subterranean, but upright or trailing along the ground or climbing, frequently to the distance of many feet, and throwing out radicles, wherever they bifurcate. A transverse section of the root shows the longitudinal ducts to be collected in the axis. In the stem they are similarly arranged, the vessels and ducts in this order are ordinarily of the spiral kind. The stomata on the epidermis of the leaves are very abundant, the epidermis itself being reticulated, not as in the Ferns, but into regular four-sided meshes.

REPRODUCTION. The thecæ are sessile, either in the axils of the ordinary leaves, or of scales collected into terminal spikes or catkins. They are of one kind in most of our species, consisting of kidney-shaped cases filled with minute spores, resembling the small spores of Isoetes. In *Lycopodium selaginoides*, and many foreign species, which are now generally separated as a distinct genus, under the name of *Selaginella*, the lower scales of the spikes have larger thecæ,

* A good account of the growth of this young plant is given in Müller's essay on *Isoëtes*, translated in the 'Annals of Natural History,' 2d series, vol. ii, but he was unacquainted with the earlier history of the spores, which will be found in detail in Hofmeister's works, referred to under *Equisetaceæ*.—A. H.

which contain only four large globular spores, analogous to the large spores of Isoetes. The germination of the spores has been traced in some of the foreign species of Selaginella, and the history of the two kinds is essentially the same as that of the two kinds in Isoetes. The larger are true spores, and are fertilized by the smaller in the same way, by means of active ciliated filaments. The history of the reproduction of the true Lycopodia possessing, only one kind of spore is as yet unknown. The majority of our species are in this position; their (small) spores have never been made to germinate.*—A. II.]

DISTRIBUTION.—“The Lycopodiaceæ for the most part affect exposed situations on open heaths, or the summits and sloping acclivities of mountains; although without altogether shunning more shady homes. *L. selaginoides* inclines to the most humid situations, growing frequently in the crevices of dripping rocks, about waterfalls, and in swampy ground, where water oozes from the sides of hills. *L. inundatum* occurs in analogous situations, on lower or more southern heaths and commons. The other four species choose drier dwelling-places; *L. selago* and *alpinum* bearing the rude exposure of the mountain summits; and *L. annotinum* and *clavatum* being more frequent on the sloping acclivities than on the summits; but none of these four are exclusively restricted to such situations. The order is pre-eminently boreal and alpine, only one species, *L. inundatum*, being at all frequent in the low counties of the south-east of England, and decreasing in abundance towards the northern and hilly counties; whilst all the rest prevail in the Scottish Highlands, and decrease in frequency in a southward course.”—*Mr. Watson's MS.*

VIRTUES.—Seldom used in medicine, where safer drugs are attainable. The Orkney Islanders use *L. selago* and *clavatum* as a cattle remedy; it is said to cure sheep of vermin and of different cutaneous disorders; in the human subject it is an emetic and purgative. The spores are highly inflammable, and were once imported in some abundance from Germany and Sweden to imitate lightning at the theatres, but latterly powdered resin has been substituted. *Lycopodium clavatum* is said to be valuable in dyeing woollen cloths, and for making mats it is admirable; and the Poles make a decoction of its leaves as a remedy for the disorder called *Plica polonica*. The spores are wetted with so much difficulty that when spread on the top of the water in a basin, a finger may be plunged to the bottom without becoming wet.

MARSILEACEÆ.

(Including only *Pilularia*.)

PART OF THE MARSILEACEÆ, *Br.*, *Brongn.*, *Decan.*, *Hook.*, *Grev.*

HYDROPTERIDES, *Willd.*

RHIZOSPERMÆ, *Roth.*

RHIZOPTERIDES, *Mart.*

RADICALIA, *Hoffm.*

RHIZOCARPÆ. *Batsch.*

* See Hofmeister, loc. cit.—A. II.

STRUCTURE.—The stem of *Pilularia* (see woodcut to this genus), which is the only English genus of this order, is creeping, and set at intervals with leaves, roots, and fruit. The leaves, or petioles as some call them, are curled up in veneration, as in the *Polypodiaceæ*, have stomata upon their epidermis, and a cross section of them shows that they are divided longitudinally into various cells, separated from each other by septa radiating from the centre, and forming by their union a kind of axis, composed of dotted ducts or spiral vessels. The roots and stems are similarly constructed.

[**REPRODUCTION.** The thecæ are contained in round, coriaceous, brown, hairy sporanges, divided into four cells. They contain globules of two kinds; the first small round grains, resembling pollen-grains. These occupy principally the upper part of each sporange; in the lower are found much larger bodies, which are oval, rather pointed, contracted in the middle, and at their apex have a conical projection. These are fertile spores, and as well as the former are contained in membranous bags (the thecæ).—A. II.] A very valuable paper by Mr. Valentine, upon “The Germination and General Structure of *Pilularia*,” was read some years ago before the Linnean Society, and is to be found in their ‘Transactions,’ for 1841, page 483. It gives an excellent account of the formation of the spores, and likewise of the germination, but he overlooked the process of fertilization. Speaking of the larger spore, he says:—“The first external sign of germination is the appearance of four cells projecting through the apex. The enlarged cellular mass then distends the conical projection, and at length appears with four of its cells projecting beyond the general mass, and compressed into a quadrangular form.” [These cells are, in fact, the summit of an archegonium like that of *Isoetes*, &c., and the germinal vesicle lying at the base of this is fertilized by active spiral filaments, developed in and discharged from the small spores, as in the *Lycopodiaceæ* and *Isoetaceæ*.—A. II.] “These projecting cells soon harden, and acquire a reddish-brown hue—soon after which little fibrillæ or rootlets begin to shoot from one side. They are simply articulated tubes, or elongated cells applied end to end, each produced from one of the cells of the germ (“prothallium”). The germ (“embryo”) now gradually points in two places, which are by no means fixed, but occur in various situations, according to the position of the sporule in respect to light. These two points gradually lengthen, and if dissected, each will be found to consist of a closed sheath, containing in one instance the leaf, in the other the root, in the form of a conical process like a finger in a glove. Besides this sheath which embraces the upper part of the root, there is an exceedingly delicate expansion which closely embraces the extremity of the root like a cap. After the leaf has grown to be many times the length of the sporule, or about two lines long, another leaf grows from the germ close to the first, to which it is in all respects similar; and then a bud begins to be developed from some indefinite part of the germ, and like the leaves and root form within a sheath. This bud is covered by a peculiar kind of jointed hairs, whose attachments are lateral at a short distance from their bases.”

Mr. Valentine then shows the origin and progress of the sporules within the

theca, making afterwards the following pointed remark:—"This account of *Pilularia* shows that it is incorrect to say of *Acrogens* that germination takes place at no fixed point, but upon any part of the surface of the spores; for it is quite certain in this instance that germination invariably takes place at a fixed spot, which may be pointed out before germination has commenced." This view exactly accords with some experiments I have instituted, and with the remarks of Dr. Lloyd, who read a most interesting paper upon this subject, before the British Association, in 1836. The statement in Lindley's '*Nat. Sys.*,' ed. 2, page 416, that the capsule never produces but one plant, is not correct, for if the theca be broken and its contents scattered, as many of the large spores will germinate as happen to be fertilized.*

DISTRIBUTION.—"The solitary species of this order belonging to Britain is widely distributed, being found in Devon and Sussex, and extending at intervals from those counties northward to Sutherland. It is either frequently overlooked, or is otherwise a scarce plant in the south of England, increasing in plenty in the northern counties; probably the drier climate of the south-east of England, causing the small pools to diminish much or entirely to dry up in summer, is adverse to the existence of a plant that is adapted to grow within the shallow margins of ponds and lakes. Of its range in altitude, little seems to have been yet ascertained."—*Mr. Watson's MS.*

GENERA.

THE first order of the Ferns is conveniently divided into the sub-orders *Nudæ* and *Indusiata*, according as the sori are naked or covered with an indusium. The arrangement of the species into Genera depends upon the shape and position of the sori, together with the nature, the adherence, and the manner of opening of the indusium, when there is one. In the other orders the same principles are adopted, as far as their structure will admit.

As the orders of the Fern Allies contain each but one British genus, the characters of that genus are but a recapitulation of those of the order itself.

* *Thecæ on the backs of the leaves.*

NAKED, OR WITH AN INCONSPICUOUS INDUSIUM.

Sori linear or oblong, scattered, with an inconspicuous indusium	}	GRAMMITIS.
Sori round, scattered, without an indusium		
Sori linear, forked, without an indusium		POLYPODIUM.
		GYMNOGRAMMA.

* Further particulars of these phenomena, in this family as in the others, will be found in the works of Hofmeister above mentioned. A general sketch of the whole, by the Editor of this edition, will be found in the '*Reports of the Brit. Association*' for 1851, and another in the '*Annals of Nat. History*,' 2 ser., vol. ix, and these contain references to all the original authorities.—A. H.

† † EVIDENTLY INDUSIATE.

Indusium distinct from the Frond.

- Sori round. Indusium cleft into hair-like segments . . . WOODSIA.
 Sori round. Indusium hood- or bladder-shaped . . . CYSTOPTERIS.
 Sori round. Indusium shield-like, either round or kidney-shaped . . . } ASPIDIUM.
 Sori linear or oblong, transverse, solitary. Indusium from lateral veins, opening towards the midrib . . . } ASPLENIUM.
 Sori linear, transverse. Indusium splitting down the middle, and turning back to each side . . . } SCOLOPENDRIUM.
 Sori linear, longitudinal, close to the midrib. Indusium separating next the midrib, and turning outwards . . . } BLECHNUM.

Indusium apparently part of the Frond itself reflexed.

- Sori linear, continued around the margin of the leaflets; reflexed margin membranous . . . } PTERIS.
 Sori on transverse veins, near to the margin; reflexed margin unaltered . . . } CRYPTOGRAMMA.
 Sori in distinct spots, attached to the cover itself; reflexed margin membranous . . . } ADIANTUM.

** *Thecae in marginal receptacles.*

- Thecae in deeply cup-shaped receptacles . . . TRICHOMANES.
 Thecae in compressed, two-valved receptacles . . . HYMENOPHYLLUM.

*** *Thecae on divisions of the leaf destitute of parenchyma.*

- Thecae stalked, reticulated, terminating a bipinnate leaf . . . OSMUNDA.
 Thecae sessile, smooth, in a separate compound spike . . . BOTRYCHIUM.
 Thecae sessile, smooth, in a separate simple spike . . . OPHIOGLOSSUM.

*** Thecae in catkins, terminating a hollow, jointed, and apparently leafless stem . . . } EQUISETUM.

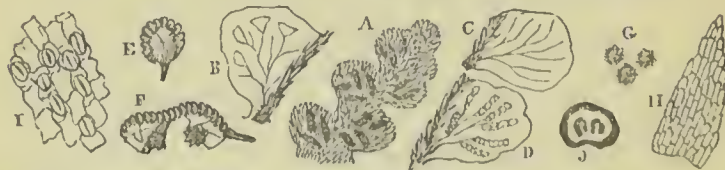
*** Thecae imbedded in the base of radical leaves . . . ISOETES.

**** Thecae in the axils of the ordinary leaves, or of scales gathered into terminal catkins . . . } LYCOPODIUM.

**** Thecae in sporanges, stalked upon the creeping stem, near the bases of the leaves . . . } PILULARIA.

GRAMMITIS. Swz. GRAMMITIS.

(*Γραμμα*, a line; alluding to the linear fructification.)



A shows the under surface of the leaf of *Grammitis ceterach*. B, the veins according to Newman.* C, the veins according to Prest. D, position of the fruit. E, an unopened theca. F, a theca scattering its spores. G, the spores. H, a scale. I, epidermis and stomata. J, transverse section of the leaf-stalk.

* Inaccurately copied.—Ed.

GRAMMITIS CETERACH.

SCALY GRAMMITIS. SCALY HART'S TONGUE. MILTWAST.

(Plate I, fig. 1.)

CHA.—Leaf linear-lanceolate, pinnatifid, scaly beneath. Lobes alternate, confluent, blunt, with waved margins.

SYN.—Grammitis ceterach, *Swz.*, *Hook.*, *Mack.*—Asplenium or ceterach, *Ger.*, *Ptum.*, *Ray.*—Asplenium ceterach, *Linn.*, *Huds.*, *Sibt.*, *Lightf.*, *Bott.*, *With.*, *Spreng.*—Gymnopteris ceterach, *Bernh.*—Scolopendrium ceterach, *Roth.*, *Galp.*, *Smith.*—Ceterach officinarum, *Willd.*, *Decan.*, *Newm.*—Notolcpeum ceterach, *Newm.*, 1854.

FIG.—*E. B.* 1244.—*Park.* 1046, f. 1.—*Ger.* 978.—*Lobel*, 807.—*Bolt.* 12 (*bad*).

DES.—Rootstock perennial, fibrous, black, tufted. Leaves many from the same point, herbaceous, 3 to 6 inches high, blunt, of a thick texture, dark green above, covered with brown scales beneath. Lobes confluent at their base, round, slightly waved at the margin, alternate at the lower part of the leaf, flat only when young, afterwards eurved inwards towards the main rib, thereby exposing more the fruetification. Theeæ all the summer, at first concealed by the scales, afterwards bursting through them in oblong, transverse masses, with an inconspicuous erect membrane (indusium) at the lower side of the sori; surrounded by very delicate, white, membranous scales.

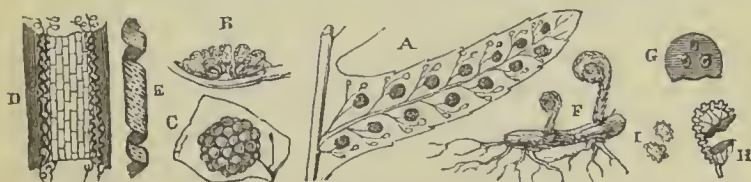
SIT.—On rocks, old walls, &c., chiefly in the South of England.

HAB.—ENG.: Near Lancaster, *Mr. W. Wilson*. Common about Settle, Yorkshire, *Mr. J. Tatham*. On limestone rocks in Lath-kill-dale, Derby., *Mr. J. E. Bowman*. On a wall at Newton, near Melbourne, Derbys., *Rev. A. Bloxam*. Dovedale, Derbys., *Mr. T. S. Schotes*. Walls at Ludlow, about the quarries, Salop, *Mr. J. S. Bayty*. Old wall near Cowley, Oxon, *Mr. Baxter*. Wall at Tocknells, near Painswick, Glou., *Mr. Merrick*. Martock, Somers., *Mr. T. H. Cooper*. Stapleton quarries, near Bristol, *Mr. Anderson*. Cheddar, *Mr. W. C. Trevelyan*. Malvern Abbey, *Mr. W. Christy*. Bath, *Mr. C. C. Babington*. On the tower of Old Alresford Church, Hants, *Mr. Forder*. Walls at Winchester, chiefly to the E. and N. E. of the city, *Mr. W. Pamplin*. Topsham and elsewhere in Devon, *Mr. Kingston*. On the bridge over the Tamar, in the road from Callington to Tavistock, *Jones's Tour*.—WALES: Denbighshire (rare), *Mr. J. E. Bowman*. Walls of a ruin at Treborth, near Bangor, *Mr. W. Wilson*.—IRE.: Ruins of Saggard Church, *Mr. Kelly*. Walls near Cork, also near Kilkenny, and in county Clare, *Mr. Mackay*. Cave-hill, *Mr. Templeton*. Headford, Galway, *Mr. Shuttleworth*.

GEO.—Holland, Spain, France, Switzerland, Nassau, Jena, Leipsic, and other parts of Germany, the Tyrol, Sicily, and the Canary Islands.

POLYPODIUM. Linn. POLYPODY.

(Πολυς, many, and πους, ποδες, a foot; from its numerous roots.)



A, pinnule of natural size of *Polypodium vulgare*. B, magnified section of a

sorus. C, front view of ditto. D, longitudinal section of leaf-stalk. G, transverse ditto. E, scalariform duct. F, veneration, rootstock, and roots. H, I, theca and spores.

Sprengel enumerates no less than 250 species of this genus; all of them are herbaceous, some a few inches only, and others several feet in height. Inhabitants of most parts of the world, particularly of the islands within the Tropics; several are found on the continent of America, and a few are confined to China. Only four species are British.*

1.—POLYPODIUM VULGARE.

COMMON POLYPODY. POLYPODY OF THE OAK. WALL FERN.

(Plate I, fig. 2.)

CHA.—Leaf deeply pinnatifid, lanceolate. Lobes broadly linear, obtuse, somewhat serrated. Leaf-stalk smooth. Rootstock hairy.

SYN.—*Polypodium vulgare*, Tourn., Ger., Park., Ray, Linn., Huds., Lightf., Ptum., Swz., Spreng., With., Smith, Hook., Mack., Gray, &c.—*Ctenopteris vulgaris*, Newm., 1854.

FIG.—E. B. 1149.—Fto. Dan. 1060.—Woodv. Med. Bot. supp. 271.—Ger. 467.—Bolt. 18.—Plu. Fil. t. A. f. 2.

DES.—Rootstock ereeping horizontally, at first covered with scales, and numerous stout, branched, hairy root-fibres. Leaf-stalk quite smooth, yellow, void of lobes half way up. Leaf from 6 to 12 inches high, lanceolate, scarcely contracting below. Lobes broadly linear, obtuse, and slightly serrated, sometimes wanting the serratures, at others acuminate, while occasionally they are found very much cut and divided. Sori naked, yellow, large, prominent, and arranged in straight lines equally distant from the margin and the midrib of the lobe; each sorus terminating one of the branches of a transverse vein. The plant is perennial, and the fruit found throughout the summer.

β. (*P. Cambricum*, Linn.) Leaf ovate; pinnules ovate and deeply cleft. (A, B.)

γ. (*sinuatum*.) Leaf ovate or triangular; pinnules proliferous. (C, D.)

δ. (*serratum*.) Pinnules distinctly and often doubly serrated.

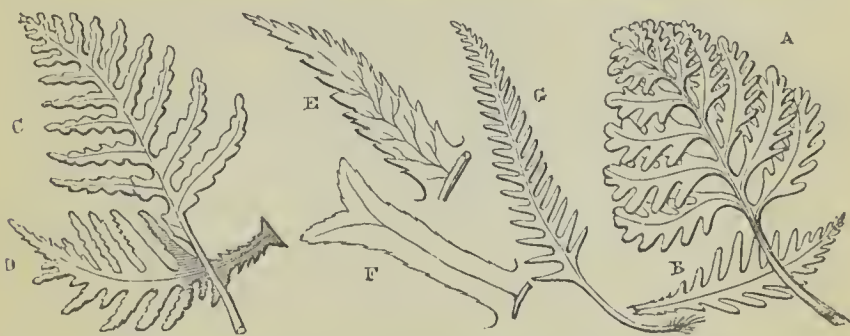
ε. (*acutum*.) Pinnules pointed; leaves long; both narrow. (E.)

θ. (*bifidum*.) Pinnules cleft at the point. (F.)

Mr. Mackay remarks, in his 'Flora Hibernica,' that the Irish plant is somewhat different from the Polyp. Cambricum of Linnæus. It is in fact our variety γ, which is the same as the Pol. Virginianum of Pursh, and intermediate between the usual state of the plant and the Cambricum; it bears fruit copiously, whereas the real Cambricum is usually without fruit, both in its wild and cultivated state. We might expect this, indeed, from the feather-like appearance of the plant, and the dilatation of its lobes, a too great expansion of leaf being here as elsewhere detrimental to the production of fruit. The foregoing observation was made in distinct reference to a frond, of which C, in the annexed cut, is an exact repre-

* The number of species in a genus is always subject to variation, particularly in one so extensive as Polypody, as newly-discovered plants are always adding to the number, while different classification often divides one genus into many.

sensation; but a plant still more nearly approaching Linnaeus's *Pol. Cambrieum* is in Sir J. Smith's herbarium, marked as from Ireland. A pinnule is represented in the fig. D, copied from the original specimen: an admirable figure of the whole frond, as well as of the *Cambrieum*, is in Newman's 'Ferns,' p. 22 (45, ed. 1854). One pinnule of the latter is represented at B, and a whole frond of it, from my herbarium, at A. The other varieties are shown at E F and G.



VIR.—Although formerly admitted into the *Pharmacopœias*, it is scarcely, if at all, used in medicine at the present day. It is feebly astringent, of a bitter and nauseous taste, and has been considered efficacious in catarrhal disorders, and against worms, in doses of from one to two drachms of the dried root.

HAB.—The common states of the plant (α and δ) are generally distributed over the United Kingdom, on trees, walls, banks, and rocks.— β . On the rocks in some parts of North Wales, but without fruit. Braid Hall, near Edinburgh, *Mr. Brown*. At Chepstow, Monm., *Sir J. E. Smith*.— γ . Woods at Dulwich (1835), *Mr. Saunders* and *Mr. W. Pamplin*. South Isles of Arran (1806), *Mr. Mackay*. In the Dargle, county of Wicklow, *Miss Filton*. Innisfallen Island, Killarney, *Mr. Kelly*. South side of King's Park, Edinburgh, *Mr. Brown*.— ϵ . Rocks in North Wales, *With*. Meadows near Maldon, and other meadows near Ewell, Surrey, *Mr. J. Bevis*. Cobham Park, Kent, *G. F.*

GEO.—Found in most of the middle parts of Europe and North America.

2.—POLYPODIUM PHEGOPTERIS.

BEECH FERN. WOOD POLYPODY. SUN FERN.

(Plate I, fig. 3.)

CHA.—Leaf bipinnatifid. Lowest pinnæ distant, deflexed; the others slightly confluent. Pinnules obtuse, entire, hairy.

SYN.—*Polypodium Phegopteris* of *Lim.*, *Willd.*, *Swz.*, *Spreng.*, *Huds.*, *Lightf.*, *Bolt.*, *With.*, *Smith*, *Hook.*, *Mack.*, *Newm.*—*Polystichum Phegopteris*, *Roth.*—*Polypodium latebrosum*, *Gray*, *Salisb.*—*Gymnocarpium Phegopteris*, *Newm.*, 1854.

FIG.—E. B. 2224.—*Boll.* 20 (*not good*).—*Flo. Dan.* 1241.

DES.—Rootstock perennial, hairy, slender, creeping horizontally. Leaf triangular, herbaceous, erect, hairy, 6 to 12 inches high. Pinnæ opposite, very acute, adnate, the lower pair bent forwards, pendulous, and distant from the pair next above them. The pinnules of all are obtuse, entire, and directed towards the point of the pinna, particularly the two lowest, which with those on the opposite

pinna form a cross. The leaf-stalk is smooth, and without pinnæ on the lower half. Sori round, distinct, very small, brown, and seated around the margin of the pinnules.

The pendulous character of the lower pinnæ, and the cruciform direction of their bases are most apparent in vigorous plants, and serve as characters which immediately distinguish this plant from its congeners.

SIT.—In moist woods and rocky dells, chiefly in mountainous countries.

HAB.—ENG.: Rocks at the foot of Cheviot, above Langley Ford, *Mr. Winch*. Cawsey Deau, Durham, *Mr. R. B. Bowman*. Around Keswick, Cumb., *Mr. H. C. Watson*. Wensley-dale, Yorks., *Mr. J. Ward*. Common about Settle, Yorks., *Mr. J. Tatham*. Prestwich Clough and Boghart Clough, Lancashire, *Mr. Merrick*. Egerton Moss, near Bolton, *Mr. W. Christy*. Rocks at the Belle Ilag, one mile from Sheffield, *G. F. Norwood*, Surrey, and near Brentford, Middx., *Mr. J. Bevis*. Lidford Fall, Beckey Fall, Dartmoor, Devon, *Jones's Tour*. Isle of Man, *Mr. E. Forbes*.—WALES: Llanberris, first and second field towards Snowdon, *Mr. C. C. Babington*. Capel Curig, North Wales, *Mr. T. H. Cooper*. Frequent in Caern., not at any considerable elevation, *Mr. W. Wilson*.—SCOT.: Grampians, Aberdeensh., Red Caird Hill, W. of Invernesshire up to 1150 yds., Forfarshire, Sutherland, Dumbarton, and other parts of the Highlands, *Mr. H. C. Watson*. Moray, and Rosshire, *Rev. G. Gordon*. Ben Lomond, *Prof. Henslow*. Ruberslaw, Jedburgh, &c.—Campsie, near Glasgow, *Mr. T. H. Cooper*.—IRE.: Powerscourt Waterfall (right-hand side), *Mr. O. Kelly*. Waterfall above Lough Eske, co. of Donegal, and at other places in the northern counties, *Mr. Mackay*.

GEO.—Throughout Germany, and indeed most European countries as far north as Lapland, but not in the South countries. Linnaeus received specimens from Canada.

3.—POLYPODIUM DRYOPTERIS.

TENDER THREE-BRANCHED POLYPODY.

(Plate I, fig. 4.)

CHA.—Leaf-stalk three-branched above, the divisions bipinnate, tender. Branches drooping. Pinnules obtuse, crenate, glabrous. Sori distinct.

SYN.—*Polypodium Dryopteris* of *Lin.*, *Willd.*, *Swz.*, *Ehrh.*, *Huds.*, *Bolt.*, *Lightf.*, *Hull.*, *Galp.*, *With.*, *Newm.*, *Smith*, *Hook.*, *Grev.*, *Mack.*—*Polypodium pulchellum*, *Gray*. *Polystichum Dryopteris*, *Roth.*—*Gymnocarpium Dryopteris*, *Newm.*, 1854.

FIG.—*E. B.* 616 (*excellent*).—*Bolton*, 28 (*bad*).—*Gerard*, 974.—*Park*. 1044.

DES.—Rootstock perennial, creeping, black, slender, slightly hairy. Leaves herbaceous, scattered, tender, drooping, smooth, and of a light green colour. The three branches (of which the middle may be considered a continuation of the main stalk) are bent backwards, and doubly pinnate. Pinnules slightly crenate, oblong, obtuse. Main stalk 6 to 8 inches long below the branches, quite smooth, except at the very base. Sori nearly marginal, scattered, remaining perfectly distinct.

SIT.—Dry stony places, chiefly in mountainous countries of the north.

HAB.—ENG.: Rocks at the foot of the Cheviot, above Langley Ford, *Mr. Winch*. Wooded banks of the White Adder, between the Retreat and Elm Cottage, Berwickshire, *Dr. Johnston*. Durham, *Mr. R. B. Bowman*. Near Yoxhall Lodge, in Needwood Forest, Staffordsh., *Mr. C. C. Babington*. Cumberland, up to 500 yards of elevation, *Mr. H. C. Watson*. Higher part of the Tees, *Mr. J. Hogg*. Egerton Moor, near Bolton, *Mr. W. Christy*. Dean Church, Clough, near Bolton, *Mr. J. Martin*. Dry places near Lancashire (sparingly), at Hill Cliff, Cheshire, and at Warrington, *Mr. Rylands*. Boghart Hole Clough, and Prestwich Clough, Lanc., *Mr. Merrick*. Rocks at the Belle Hag, Sheffield, *G. F. Froddesley Hill*, Salop, *Rev. W. Corbett*. N. side of Titterstone Cleve Hill, Salop, *Mr. E. Lees*. Near Richmond, Yorks. *Mr. J. Ward*. Near Bristol, *Miss Worsley*.—WALES: Craig Breidden, Montgomerysh., *Mr. J. E. Bowman*. Rhaiadr-y-Wenol-Twll Du, Carnarvonsh., *Mr. C. C. Babington*. Frequent in N. Wales, and observed near Twll Du at an elevation of 1000 feet and upwards, *Mr. W. Wilson*. Just leaving Llangollen, on a slate rock, *Mr. W. Wilson* and *Mr. Bowman*.—SCOT.: Moray, Rossh., *Rev. G. Gordon*. Perthshire, Forfarshire, Aberdeenshire, *Mr. H. C. Watson*. Hawthorn Dean, near Edinburgh, *Mr. T. H. Cooper*.—IRE.: On the mountains of Mourne, Turk Mountain, Killarney, Mam-turk, Connamara, Tullamore Park, &c., *Mr. Mackay*.

Geo.—Throughout great part of Europe and North Asia.

4.—POLYPODIUM CALCAREUM.

RIGID THREE-BRANCHED POLYPODY. LIME POLYPODY.

SMITH'S FERN.

(Suppl. Plate, fig. 1.)

CHA.—Leaf-stalk three-branched above, the pair of lateral branches pinnate with pinnatifid leaflets, the middle branch bipinnate, the pinnules more and more confluent upwards, rigid. Branches upright. Pinnules obtuse, deeply crenate.

SYN.—*Polypodium calcareum*, Swz., Willd., Smith, Hook., Pursh., Galp.—*Polypodium Dryopteris*, Bolt., Dicks.—*Polypodium Dryopteris* β , With., 2d edit.—*Polypodium Robertianum*, Hoffm.—*Nephrodium Dryopteris*, Michx.—*Gymnocarpium Robertianum*, Newm., 1854.

FIG.—*E. B.* 1525.—*Bolt.* 1.—*Ger.* 1135.

DES.—This is so similar to the last, that when dried they are scarcely to be distinguished; hence the doubt of their claim as distinct species: but when growing, the eye will instantly see the difference between the two. The *P. calcareum* is known from its rootstock being thicker and less creeping, its leaves rather larger in size, much more rigid, quite upright, and of a dark green colour; its pinnules more deeply cut, and stalk more scaly towards the base, and on the upper part sprinkled over with fine white minute glandular hairs; its sori are browner and more numerous. The minute pubescence seen on this species is most observable on luxuriant and fresh plants. It is, I believe, a constant and decided character, in which opinion I am supported by Mr. Wilson and Mr. Babington, than whom few are better able to form a correct judgment. The latter gentleman observes, that the microscope shows every particle of this pubescence or mealiness to be a minute stalked gland (*vide* Plate).

Mr. Newman, in his beautifully-illustrated book on Ferns, blends this with the former species; yet his figures show strongly-marked differences.* Both of us, no doubt, argue according to our respective means of observation; and after a very careful re-examination of both the species in my own and Sir J. Smith's herbarium, and also as growing in Kew Gardens, I see no reason to alter a single word in the above descriptive characters. Whether the size of the two be of moment is the only thing which appears of little certainty; but the rigid erect habit and dark colour are very characteristic, even without noticing the pubescence. Indeed, whatever doubt I may have of the distinctness of certain others of the Ferns, I cannot for an instant consider the present and former species identical; let it be observed, however, that in the case of these, as well as some other species, the same herbarium often contains but the commoner plant, which is the *P. Dryopteris*, yet some of the specimens may be under the name of *P. calcareum*; and too often does it happen, that the receiver of a specimen, taking for granted that such is correctly named, makes it a guide for his own future judgment, and thus an error becomes perpetuated.†

HAB.—Arnclyff and Gordale, Yorks., *Mr. R. B. Bowman*. Near Lancaster, *Mr. Gibson*. Sheddin Clough, three miles from Burnley, Lanc., *Mr. Leyland*. Common about Settle, Yorks., *Mr. J. Tatham*. Matlock Bath, Derbys., *Dr. Howitt*. Road-side under the Lover's Leap, near Buxton, Derbys., *Mr. H. C. Watson*. Cheddar Cliffs, Somers., *Mr. W. Christy*. Box Quarries, near Bath, *Mr. Flower*. Not found in either Scotland or Ireland.

GEO.—Recorded by Pursh and Michaux as occurring throughout North America from Canada to Pennsylvania, and no doubt this is correct, as the description of Pursh so exactly accords with our plant; though Swartz says that it is found in England only.

5.—POLYPODIUM ALPESTRE.

ALPINE POLYPODY.

(Suppl. Plate, fig. 2, A.)

CHA.—Leaf lanceolate, bipinnate. Pinnæ linear-lanceolate. Pinnules deeply pinnatifid, with sharply-toothed ovate lobes.

SYN.—*Polypodium alpestre*, *Spreng.*, *Moore* (1853).—*P. rhætium*, *Woods' Tourist's Flora*.—*Pseudathyrium alpestre*, *Newm.* (1854).

FIG.—*Moore* (1853), p. 51.—*Newman* (1854), p. 199.

DES.—Rootstock short, decumbent, with a tendency to branch; with the leaves in terminal tufts. Leaves 1—3 feet high, the bare part of the stalk short, with few scales; blade lanceolate in outline, bipinnate, the pinnæ linear-lanceolate, acute; pinnules elongate-triangular, shortly stalked, deeply pinnatifid, the lobes having coarse acute teeth. Sori at first small and circular, afterwards often confluent on the larger pinnules.

SIT.—Alpine glens.

HAB.—Ben Alder, Invernesshire, Canlocken Glen, Forfars., *H. C. Watson, Esq.* Clova Mts., *Messrs. Backhouse and Westcombe*.

GEO.—Mountains of Scandinavia, Germany, Switzerland; Russia.

* It is admitted as a species in the latest edition (1854).—ED.

† The figure given in Pl. I, fig. 5, is *P. Dryopteris*.—ED.

(*P. flexile*, *Moore*; *Pseudathyrium flexile*, *Newm.*, fig. p. 203 (1854); (Suppl. Plate, fig. 2, B); has the pinnæ deflexed and the pinnules somewhat lanceolate from a narrow base. It was found with *P. alpestre* by Mr. Backhouse, and perhaps is not distinct.)

GYMNOGRAMMA, Desvaux.

(Named from *γυμνος*, *naked*, and *γραμμά*, *a line*, in allusion to the naked linear sori).

This genus is distinguished by its linear forked sori, which ultimately become confluent, bearing the thecæ on the backs of the veins of the leaf. It consists of a number of elegant little Ferns, chiefly tropical, of which the silver and gold Ferns commonly cultivated in hot-houses are examples; the yellow or white dust on the backs of the leaves of these species consists of fine hairs.

GYMNOGRAMMA LEPTOPHYLLA.

SCALE-LEAVED GYMNOGRAM.

(Suppl. Plate, fig. 3.)

CHA.—Leaves ovate, bipinnate. Pinnules roundish wedge-shaped, about 3-fid; the segments obtuse, bifid.

SYN.—*Gymnogramma leptophylla*, *Moore*, *Newm.*—*Polypodium leptophyllum*, *Lim.*—*Gymnogramma leptophylla*, *Swetz.*

FIG.—*Moore* (1853), p. 63.—*Newm.* (1854), p. 11.

DES.—Rootstock erect. Leaves tufted, 4 to 8 inches high when well developed; leaf-stalk about half the length, brown and shining, blade ovate bi- or tri-pinnate, the pinnæ alternate, ovate, with alternate pinnules. Pinnules trifid above, wedge-shaped below, the segments bifid, stalk of the pinnules somewhat decurrent. Sori forming two lines diverging from one point on the back of each segment of the pinnule.

SIT.—Wet places, where *Marchantia* flourishes.

HAB.—Jersey, *Mr. Ward*, *M. Piquet*.

GEO.—Madeira, Azores, Spain and Portugal, France, Italy, Sicily, Greece, and, according to Kunze, Mexico.

WOODSIA, Br. HAIR-FERN.

(Named in honour of Mr. J. Woods, an English Botanist.)



A, portion of a leaf of *Woodsia Ilvensis*, natural size. B, ditto enlarged. C, sorus perpendicularly divided. D, indusium. E, one portion of ditto. F, scale. G, theca. H, spores.

Mr. Brown first separated from the *Polypodia*, &c., this very distinct genus, which contains only two British and four foreign species, all very small plants, and natives of mountainous regions. The indusium, if such it can be called, is very singular and beautiful: it is attached under the mass of thecæ—inclosing

them at first in a bag, it then becomes split into numerous segments, which look like hairs interspersed with the thecæ, and were so considered until Mr. Brown showed their true nature in 'Trans. Linn. Soc.,' vol. xi.

WOODSIA ILVENSIS.

OBLONG WOODSIA. HAIRY WOODSIA. DOWNY HAIR-FERN.
RAY'S WOODSIA.

(Plate I, fig. 6, A.)

CHA.—Leaf pinnate, lanceolate, sealy. Pinnæ lanceolate, blunt, more or less deeply pinnatifid, erenate.

SYN.—*Woodsia Ilvensis*, Brown, Smith, Hook., Spreng.—*Polypodium Ilvense*, Swz., Willd., Schk.—*Aerostichum Ilvense*, Linn., Huds., Ehrh.—*Polypodium Arvonieum* of With., in description but not in references.*

FIG.—*E. B. Supp.* 2616.—*Flo. Dan.* 391.—*Pluk. Phyt.* 281, fig. 4 (good).

DES.—Rootstock perennial, tufted, black, smooth. Leaves numerous, 1 to 4 inches high, covered with capillary, brownish-white scales. Leaf-stalk sealy; the lower third of it without pinnæ, the upper two thirds containing six to eight pairs, placed nearly opposite to each other. Lower pinnæ cut into from four to six blunt segments on each side. Sori scattered, convex, consisting of five or six roundish thecæ. Indusium torn into a few capillary divisions.

Mr. Sowerby observes, that the capillary segments of the indusium are not so numerous as in the next species, and the thecæ more spherical. The plant cultivated and formerly sold at the London nurseries, under the name of *Woodsia Ilvensis*, is *Notholaena distans*, a plant in every respect different from ours, which is much smaller, and less white and downy than that New Holland species.

SIT.—On rocks in mountainous countries.

HAB.—Higher parts of the Tees, *Mr. J. Hogg*. Rocks (near where *Oxytropis campestris* grows), between Glen Dole and Glen Phee, in the Clova Mountains, Forfarshire, at 550 yards of elevation, *Mr. H. C. Watson* (from which station it is larger than the Welsh plant). On the Basaltic Rocks, called Falcon Clints, near Caldron Spout, Teesdale, *Mr. R. B. Bowman*. Glydes-vawr, near Lyn-y-cwm, *Mr. Winch*. Last seen in July, 1836, by *Mr. W. Wilson*.

Geo.—Found in different parts of Germany, as on the Alps of Salzburg and Carinthia, the Giant and Hartz Mountains, &c.; in Sweden, Norway, and the Isle of Elba or Ilva (whence the name *Ilvensis*); also in Italy, Siberia, and on the Pyrenees. Pursh says, from Canada to Virginia; but it may be much doubted if our plant be here indicated.

WOODSIA HYPERBOREA.

ROUND-LEAVED WOODSIA.

(Plate I, fig. 6, B.)

CHA.—Leaf pinnate, linear-lanceolate, nearly smooth. Pinnæ triangular, blunt, deeply erenate.

* I cannot refer to Withering's *Polypodium Arvonieum* and *Ilvense* with certainty, as his descriptions of these two plants are very obscure and far from characteristic.

SYN.—*Woodsia hyperborea*, Br., Hook., Smith, E. Fl., Galph.—*Acrostichum alpinum*, Bott.—*Ceterach alpinum*, Lam., Decan.—*Polypodium hyperboreum*, Swz., Willd., Spreng., Smith, in E. B.—*Woodsia alpina*, Newm., 1854.

FIG.—E. B. 2023.—Bolt. 42.—'Linn. Trans.' vol. xi.—Pluk. Phyt. 89, f. 5.

DES.—Rootstock perennial, fibrous, black, tufted, and very long, giving rise to many linear-lanceolate pinnate leaves, from 2 to 4 inches high. Lower part of the stem covered with light-brown capillary scales. Leaves with eight or ten pairs of pinnæ, only the two or three lower pairs opposite, and these not constantly so, all nearly smooth, bluntly triangular, deeply crenate, or cut into two or three segments on each side. The upper half of each pinna larger than the other, and in luxuriant specimens cut into pinnules near the stem. Sori from six to ten on each pinna, placed near the edge, light brown, very large, and often confluent.

From the very numerous segments of the indusium, a sorus appears like a bunch of hairs. The distinctive character, however, is chiefly the less cut, shorter, and more alternate pinnæ. The plant known as *Woodsia hyperborea* by gardeners is in reality a large variety of *Woodsia Ilvensis*, known as such before the separation of the present from that species.

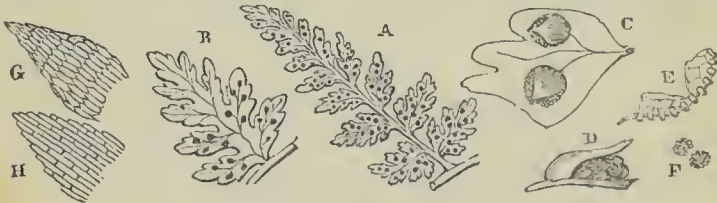
SIT.—Found only on the highest rocks and mountains of Wales and Scotland.

HAB.—Ben Lawers, Dr. Murray and Mr. W. Wilson. Clova Mountains, Mr. G. Don. Craig Chailcach, Perthsh., Mr. Maughan. Mael Ghyrddy, Perthsh., and on Snowdon, below Bwlch-y-Saeth (Clowwyn-y-Garnedd), at an elevation of 2500 feet and upwards, very sparingly, Mr. W. Wilson. Mr. C. C. Babington says, "I was not able to find this plant on Glydr Fawr, Caernarvonshire, July, 1835, although in company with J. Roberts, Esq., of Bangor, who knew its station well. It is, I fear, exterminated in that place." I searched for it in the same spot in 1837, and a botanical friend in 1840, but both without success.

GEO.—Lapland, Germany (?), France (?) (Swz.), Lulea, in Lapland (Spreng.), Canada, and high mountains of Pennsylvania and Virginia.

CYSTOPTERIS, Bern. BLADDER-FERN.

(Κυστίς, a bladder, πτερίς, a fern; the indusia being like bladders.)



A, one of the pinne of the leaf of *Cystopteris fragilis*. B, a pinnule magnified. C, young sori and indusia. D, sorus cut perpendicularly. E, theca. F, spores. G, indusium magnified from Bauer's 'Genera Filicum.' H, ditto from Schott's 'Genera Filicum.'

The genus is distinguished by its indusia being inflated like bags, not being attached by a central column, but only by the edge nearest this rachis, and finally either quite bent back, or thrown off altogether. They first open on the top, or on the side nearest the apex of the leaf or pinna.

1.—CYSTOPTERIS FRAGILIS.

BRITTLE BLADDER-FERN.

(Plate II, fig. 2.)

CHA.—Leaf twice-pinnate, lanceolate. Pinnæ ovate- or oblong-lanceolate. Pinnules ovate or ovate-lanceolate, deeply cut or toothed.

α. Pinnules ovate, acute, pinnatifid; segments toothed; sori becoming confluent.

SYN.—*Cystea fragilis*, *E. Fl.*—*Cystopteris fragilis*, *Hook.*, in *Br. Fl.*, *Mack.*, *Bernh.*—*Aspidium fragile*, *Swz.*, *Hook.* in *Fl. Sco.*, *Willd.*, *Grev.*, *Lightf.*—*Polypodium fragile*, *With.*, *Linn.*, *Huds.*, *Bolt.*, *Hoffm.*, *Ehrh.*, *Dick.*—*Cyathea fragilis*, *Roth.*, *Smith* in *E. B.*, &c., *Galp.*—*Cyclopteris fragilis*, *Schrad.*, *Gray*.

FIG.—*E. B.* 1587.—*Bolt.* 45-46.—*Flo. Dan.* 401.

DES.—Rootstock black, fibrous, and tufted. Leaves numerous, deciduous, bright green, from 6 to 12 inches high, twice pinnate, lanceolate, pointed, and finely tapering towards the apex. Rachis very brittle and shining, of a dark brown or black colour on the lower part, and quite smooth, except a tuft of scales at the very base. Pinnæ opposite, pointed, about twenty pairs, confined to the upper half of the rachis, and growing nearly at right angles to it. Their length more than twice their width, except the lower pair, which are also distant from the next above them. Pinnulæ alternate, acute, deeply lobed, erenate or bluntly acute, decurrent and tapering more or less at the base. Sori numerous, confluent, black when young, afterwards a shining brown, and found throughout the summer. Indusium white, with an irregular margin, and soon obliterated or thrown off by the growing thecæ.

No Ferns are more altered by circumstances than this genus, hence the difficulty of distinguishing the species. The varieties, however, are not distinct in themselves, as they may all sometimes be found upon the same plant, and different seasons produce differently-shaped and more finely-divided leaves. For example, those which arise in ordinary seasons alone answer the above description; a cold spring occasions barren leaves, the pinnules of which are rounded, delicate, wide, erenate, and running much into each other, while long-continued drought or warm weather occasions those leaves which arise in summer to be much smaller, much yellower, more entire, and the sori more crowded. In the extreme state it may be described as follows:—Leaf linear, oblong. Pinnæ blunt, pinnate, ovate or round, toothed, quite covered with sori. If the summer continue very wet and cold, the leaves do not take the above character, but have broader and darker-coloured pinnules; in this case exactly resembling the cultivated *Cystopteris dentata*, except in the shape of the leaf itself.

SIT.—On alpine rocks and other lofty situations.

HAB.—ENG.: Near Richmond, Yorks., *Mr. J. Ward*. About Settle, Yorks., *Mr. J. Tatham*. Cumberland, Ruins of Peveril Castle, Castleton, and the Lover's Leap, near Buxton, Derbys., *Mr. H. C. Watson*. Matlock, Derbys., *Dr. Howitt*.

Cheddar, Somers., *Mr. W. C. Trevelyan*. Nottinghamsh., *Mr. T. H. Cooper* Near Bristol, *Miss Worsley*. At Exwick, near Exeter, *Mr. Jacob*.—WALES: Cave at Clogwyn Coeh, Snowdon, and rocks above Cwm Idwel, near Tŷll Du, *Mr. W. Wilson*. Near Wrexham, Denbighsh., *Mr. J. E. Bowman*.—SCOT.: Aberdeenshire, *Mr. H. C. Watson*. Moray and Ross-shire, *Rev. G. Gordon*. Near Maens, Berwicksh., *Rev. A. Baird*. Sutherland and the Kineardineshire Coast, *Dr. Murray*. Near Killin, *Mr. W. Wilson*.—IRE.: Rocks and mountains of Kerry, *Mr. Mackay*. Lough Inn, and Lough Derryelare, Connamara, *Mr. Shuttleworth*.

GEO.—Common in Germany, Saxony, Switzerland, Holland, &c.

β (*angustata*). Leaf oblong-ovate. Pinnæ lanceolate, pointed. Pinnules linear-lanceolate, toothed; teeth acute.

Cyathea angustata, *E. B.* and *E. F.*—*Polypodium rhætium*, *Dick.*, *Bolt.*—*Aspidium rhætium*, *Willd.*—By no means the *Polypodium rhæti* of *Linneus*, nor the *Polypodium tenue* of *Hoffm.*, which is the *Aspidium intermedium* of modern authors.

Very distinct as a variety, not a species. It differs from the usual state of the plant only in a rather larger and broader leaf, with pinnules doubly toothed and slightly pointed.

γ (*dentata*). (Pl. II, fig. 1.) Leaf oblong-lanceolate. Pinnæ ovate or ovate-lanceolate. Pinnules ovate, obtuse, erenate. Sori distinct.

Cystea dentata, *Eng. Fl.*—*Cyathea dentata*, *Eng. Bot.*, *Dar. W. Bot.*, *Galp.*—*Polypodium dentatum*, *Dicks.*, *Willd.*, *Hull.*—*Aspidium dent.*, *Swz.*, *Willd.*, *Hook.*, *Fl. Scot.*, *D. C.*—*Athyrium dentatum*, *Gray*.

FIG.—*E. B.* 1588.—*Pluk. Phyt.* 179, fig. 5 (cultiv. spec.)—*Bolton*, 27.

This variety is known from the preceding forms by the shape of the leaves and pinnules; the latter are much more obtuse, rounder, and less divided; the leaf-stalk is shorter and less brittle; and the whole plant smaller (leaves 6—9 inches high).

[δ (*Dickieana*). (Suppl. Plate, fig. 4.) “Leaf ovate-lanceolate; pinnæ deflexed, overlapping; pinnules crowded, broad, obtuse, very slightly toothed; sori marginal, distinct.”

Cystopteris Diekieana, *Sim.*, ‘*Gard. Journ.*’ 1848, *Newm.*—*Cystopteris fragilis*, var. *Diekieana*, *Moore*.—*C. dentata*, var. *Diekieana*, *Babington*.]

FIG.—*Moore*, ‘*Brit. Ferns.*’ 2d ed. p. 77.—*Newman*, ‘*Brit. Ferns.*’ 3d ed. p. 93.

This form, which has been found only in a cave near the sea at Aberdeen, is distinguished by its broad, blunt, overlapping pinnules, which are often confluent above. It averages from 4 to 6 inches high. Mr. Babington, who gives *C. dentata* as a species, considers this a form of that plant, and Mr. Moore inclines to the same view.—ED.]

2.—CYSTOPTERIS MONTANA.

MOUNTAIN BLADDER-FERN. WILSON’S BLADDER-FERN.

(Suppl. Plate, fig. 5.)

CHA.—Leaf triangular, tripinnate. Pinnæ and pinnules spreading. Pinnules linear-oblong, incised-toothed or pinnatifid, the segments notched at the ends.

SYN.—*Cystopteris montana*, *Link.*, *Hooker*, *Hooker and Arnott*, *Babington*, *Moore*, &c. &c., *Newm.*, 2d ed.—*Cystopteris myrrhidifolia*, *Newm.*, 1854.—*Cyathea montana*, *Roth.*—*Polypodium myrrhidifolium*, *Vill.*—*Polypodium montana*, *Allioni*.—*Aspidium montanum*, *Sw.*, *Schkuhr*.

FIG.—*Newman*, 3d ed. (1854), p. 97.—*Moore*, 2d ed. (1853), p. 81.—*Schkuhr*, pl. 63.

DES.—Rootstock black, fibrous, creeping extensively. Leaves triangular, small, on a long leaf-stalk, tripinnate in the lower part, bipinnate in the upper pinnæ. Pinnæ and pinnules spreading; the lower pair of pinnæ much larger than the rest, with their lower basal pinnules much larger than the upper, and more decidedly pinnate. Sori numerous. Indusium sub-rotund, very obtuse.

HAB.—Breadalbane Mountains; Ben Lawers, *W. Wilson, Esq.*, 1836. Corrach-Uachdar, *Messrs. W. Gourlie and W. Adamson*, 1841. Corrach Dh'Outillach, *W. Borrer, Esq.*, and *Dr. Arnott*. Near the last station, *Mr. Westcombe*, 1853, *Rev. W. Little*.

GEO.—Mountains in all parts of Europe. Rocky Mountains, North America. Kamtschatka.

3.—CYSTOPTERIS ALPINA.

ALPINE BLADDER-FERN. LACINIATED BLADDER-FERN.

(Plate II, fig. 3.)

CHA.—Leaf tripinnate, ovate, lanceolate. Pinnules ovate, blunt. Segments linear, obtuse, toothed.

SYN.—*Cystopteris alpina*, *Hook. in Br. Fl., Desv.*—*Cystopteris regia*, *Bernh.*—*Cyathea incisa*, *Smith in E. Bot., Galp.*—*Cyathea alpina*, *Roth.*—*Cystea regia*, *Smuth in E. Fl. and Fl. Br.*—*Polypodium regium*, *Linn., Hull.*—*Polypodium trifidum*, *With.*—*Polypodium alpinum*, *Jacq., Schk.*—*Athyrium alpinum*, *Spreng.*—*Athyrium regium*, *Gray.*—*Aspidium alpinum*, *Suz., Willd., Hook., in Fl. Sco.*

FIG.—*E. B.* 163.—*Jacq. Icon.* vol. iii, t. 742.—*Sequier Pl. Veron. supp.* 1, 3.

DES.—Rootstock black, fibrous, tufted. Leaf tripinnate, ovate, or ovato-lanceolate, herbaceous, 2 to 6 inches high. Pinnæ about ten or twelve pairs, set rather alternately, except the lower pair, their length not above twice their width. Larger pinnules broadly ovate, or wedge-shaped, repeatedly cut into broad linear segments. Sori small, scattered, seated nearly at the apex of the segments. Margin of the indusium entire.

These marks clearly indicate this to be a distinct species, far removed from both the others, and in cultivation instead of approaching the *fragilis* or *dentata*, it becomes yet more different, as the pinnules increase in length, but scarcely in width, as in the former cases. In general habit our present species is by far the tenderest and most numerously cleft, with a shorter and less brittle rachis than *Cystopteris dentata* or *fragilis*.

The late Professor Don thought the *Cystopteris regia* and *Cystopteris alpina* to be essentially different, but Sir W. J. Hooker speaks confidently of the Layton plant being precisely the same as that represented by Jacquin and Schkuhr, which are the same as the *alpina* of Don; and as our plant at the present time has the wedge-shaped pinnules, said by Mr. Don to be peculiar to the *Cystopteris regia*,

we are bound to conclude that formerly, when the plant was vigorous, it took one character, and now that it is but struggling for existenee it assumes the other. Indeed, luxuriant plants lately received from Low Layton, through the kindness of Mr. E. H. Bolton, who gathered it as lately as 1840, confirm to me the accuracy of Sir W. J. Hooker's views upon the subject. Mr. W. Pamplin, of Queen street, Soho, an indefatigable botanist, is the re-discoverer of this plant, and kindly furnished me with specimens gathered in 1835. The first account we have of the plant as British is by Mr. Foster, in Symon's 'Synopsis,' published in 1793.

HAB.—Wall at Low Layton, Essex, 1836, Mr. W. Pamplin. The alpine stations refer to *Cystopteris fragilis*. [Not a true native.—ED.]

GEO.—Jena, Oldenburgh, and other parts of Germany, Italy, &c.

ASPIDIUM, Swz. SHIELD-FERN.

(ΑΣΠΙΣ, a shield; the indusium being of this form.)



A, pinnules of *Aspidium lonchitis*. B, portion of ditto, showing the fruit magnified. C, transverse section of a sorus. D, ditto of the leaf-stalk. E, scale magnified. F, theca and spore.

A widely-distributed and extensive genus, of not less than from 160 to 170 species, all of them herbaceous, some evergreen, others deciduous. The indusium is either reniform and fixed at the sinus, when they belong to the genus *Nephrodium* of Brown, or *Lastræa* of Bory, &c., or else orbicular and peltate, which is the true character of *Aspidium* of Brown, or *Polystichum* of Roth. (in part). The greater number of the British *Aspidia* somewhat differ from the true character of the genus, as their indusia, though orbicular, have a deep lateral notch, which occasions them to appear somewhat reniform, and hence also they in some degree cease to be peltate; but the variation is not so great as to render it advisable to separate them into two genera.

A. POLYSTICHUM.—Indusium circular, fixed by the middle.

1.—ASPIDIUM LONCHITIS.

ROUGH ALPINE SHIELD-FERN.

(Plate II, fig. 4.)

CHA.—Leaf pinnate. Pinnæ lunate, bristly-serrate. Rachis scaly.

SYN.—*Aspidium Lonchitis*, Swz., Willd., Hook., Smith, Macx., Galp., Spreng., Schk.—*Aspidium asperum*, Gray.—*Polypodium Lonchitis*, Linn., Bolt., With., Huds., Lightf.—*Polystichum Lonchitis*, Roth., Deean., Hoffm., Newm.

FIG.—E. B. 797.—Bolt. 19.—Flo. Dan. 497.—Park. 1042.—Ger. 979.

DES.—Rootstock tufted, black, fibrous. Leaves 6 to 12 inches high, numerous, dark green, arranged in a circle around the crown of the rootstock, very rigid, not growing upright, but generally half

decumbent, forming a flat, cup-shaped plant. Leaf-stalk scaly, clothed with pinnæ nearly to its base. The pinnæ are numerous, crowded, stalked, alternate, smooth above, slightly scaly beneath, crescent-shaped, with an auricle on the upper side of the base of each, serrated, with the serratures ending in a bristle, that part of the pinna above its midrib much larger than the lower portion, in position rather declining and bent forwards, so that they very often approach those on the opposite side of the rachis, the back of the leaf being outwards. Sori confined to the upper third of the leaf, arranged in single rows, black or brown, and very large. Indusium orbicular, notched, attached at the centre, and soon becoming shrivelled.

Sir J. E. Smith says, that "this plant dwindles rather than becomes luxuriant when cultivated," as it often is on rockwork, &c., forming a curious, rigid, and pretty plant, not in any way altered from its original characteristics, except becoming less spinous. The American is more spinous than our plant.

HAB.—In situations above 1000 yards, probably 1100 yards above the sea level, on the Breadalbane mountains, Perthshire, and plentiful almost everywhere in the Highland valleys, and on the declivities of the mountains. Scarcely in England, nor have I ever seen it here. Craig Chailleach, Perth., and Clova Mountains, Forfarsh., *Mr. H. C. Watson*. Falcen Clints, near Caldron Spout, Teesdale, *Mr. R. B. Bowman*. Glen Isla, Forfarsh., *Mr. W. Brand*. Aberdeenshire, *Dr. Murray*. Moray and Ross-shire, *Rev. G. Gordon*. Base of Benmore, Sutherland, *Dr. Johnston*. Very large in Glen Phee, *Mr. W. Wilson*. Clogwyn-y-Garnedd, Snowdon, *Mr. C. C. Babington*. Higher part of the Tees, *Mr. J. Hogg*. Common about Settle, Yorks., *Mr. J. Tatham*.—IRE.: In a glen E. of Lough Eske, Donegal; and on Glengade Mountain, Leitrim, *Mr. E. Mackay*. Brandon Mountain, *Mr. W. Wilson*.

GEO.—Silesia, Bavaria, the Tyrol, Switzerland, Sweden, Norway, and the Aleutian Islands.

2.—ASPIDIUM LOBATUM.

CLOSE-LEAVED, PRICKLY SHIELD-FERN.

(Plate II, fig. 5.)

CHA.—Leaf bipinnate. Pinnules decurrent, spinulose, elliptical, that next the rachis very large.

SYN.—*Aspidium lobatum*, *Suz.*, *Gray*, *Willd.*, *Schk.*, *Smith*, *Hook.* in *Br. Fl.*, not in *Fl. Scot.*, *Hook. and Arnott*, *Forst.*, *Galp.*, *Mack.*—*Polypodium lobatum*, *Huds.*—*Polypodium aculeatum*, *Bolt.*, *With.*—*Polystichum aculeatum*, *var. lobatum*, *Bab.*, 1851, *Moore*, 1853, *Newm.*, 1854.

FIG.—*E. B.* 1563.—*Bolt.* 26, f. 1 (*a full-grown*), f. 2 (*a young plant*).

DES.—Rootstock tufted. Leaves growing in a circle, rigid, glaucous green, from 15 inches to 2 feet high, evergreen, perfectly ovate. Lower pinnae crowded, so as to overlap each other; sometimes, however, the leaf is elongated at the lower part, when the pinnæ are proportionably distant. Leaf-stalk stout, scaly, and with pinnæ to the very base. Pinnae short, alternate, lanceolate, pointed,

and curved upward, therefore somewhat lunate. Smaller pinnules running much into each other, the larger slightly auricled, decurrent, and that next the rachis so much larger than the rest as to project over its next neighbour, and also partly to conceal the base of the pinna next above it; the inner edge of all the larger pinnules running parallel to the rachis, and at a little distance from it, so that if held up, a line of light will appear on each side of the rachis, except near the base, where the first pinnules are set very close to the main stem, whence perhaps its name of close-leaved. Sori large, in single rows, confined to the top of the leaf. Indusium circular, fixed by the centre, persistent, but easily knocked off.

β (*lonchitidoides*). Pinnules combined, forming nearly a pinnate leaf. *Filix lonchitidi affinis*, Ray. *A. aculeatum* β, *Smith in E. Fl.* *A. lobatum*, Hook. in *Br. Fl.* FIG.—*Pluk. Phyt.* t. 180, f. 3 (*good*).

This species is distinguished from the following, for which alone it can be taken, by the decurrent lobes; and as Sir J. E. Smith very rightly observes, “by the much shorter, more crowded, and less scaly pinnae.” Added to which, the pinnules are more entire, being but slightly auricled, very convex, thick, and of a glaucous colour, furnished with a less number of and smaller bristly serratures, sometimes wanting them entirely at the sides. The sori also are more confined to the top of the leaf, and larger than in *A. aculeatum*. The variety *lonchitidoides* is not very scaly, and in form and size exactly intermediate between this species and *A. lonchitis*.

SIT.—On shady banks and damp hedgerows, chiefly in the North.

HAB.—Extremely common in Scotland and in the north of England, gradually losing itself towards the south, and becoming more and more intermingled with *A. aculeatum*, which in its turn is superseded still more southerly by *A. angulare*. In the middle and south of England, its recorded habitats are Leicestershire, *Rev. A. Bloxam*. Common about Settle, Yorksh., *Mr. J. Tatham*. Pottery Car, near Doncaster, *Mr. S. Appteby*. Matlock, Derbysh., *Dr. Howitt*. At Studley, Sambourne, Overley, and Weatherly, Warwicksh., *Rev. W. Bree*. Lane leading to the Vaehè from Chalfont, Bucks, *Mr. A. Halley*. Near Bristol, *Miss Worsley*. Near Dorking, Surrey; in Hants, &c., *Mr. W. Pamplin*. Near Yarmouth, *Mr. Paget*. Sussex and S. Kent, *Rev. G. E. Smith*.—WALES: Near Wrexham, Denbighs., *Mr. J. E. Bowman*.—IRE.: Colin Glen, near Belfast, *Mr. J. Tempteton*. Hermitage, County Wicklow, *Dr. Osborne*. County of Derry, *Mr. D. Moore*. ♂. Glen Fee, Clova Mountains, *Mr. W. Wilson*. Braid Woods, near Ediinburgh, *Mr. H. Cooper*.

GEO.—Germany, Switzerland, &c.

3.—ASPIDIUM ACULEATUM.*

COMMON PRICKLY SHIELD-FERN.

(Plate II, fig. 6.)

CHA.—Leaf bipinnate, broadly lanceolate. Pinnules stalked, somewhat rigid, ovate, acuminate or acute, distinctly auricled, aristate. Leaf-stalk scaly.

* As many gentlemen, distinguished for their botanical knowledge, consider the *Aspld.*

SYN.—*Aspidium aculeatum*, Swz., Willd., Hook. in *B. Fl. ed.* 4, Hook. and Arnott, Smith, Gatp., Mack., Gray.—*Aspidium lobatum*, Hook. in *Fl. Scot.*, Schk.—*Polypodium aculeatum*, Linn., Huds., Lightf., Ehrh.—*Polystichum aculeatum*, Roth., Decan.—*Polystichum angulare*, Bab., 1851, Moore, 1853, Newm., 1854.—*P. aculeatum a*, Bab., 1851, Moore, 1853.

FIG.—*E. B.* 1562.—*Pluk. Phyt.* 180 f. 1 (*not good*).

DES.—Rootstock tufted. Leaves numerous, perfectly lanceolate, evergreen, bipinnate. Pinnæ alternate, gradually tapering, close together, their midribs covered with hair-like scales. Pinnules ovate, distinctly stalked, serrate, spinulose, and with an auricle on the upper side at the base of each; that next the rachis larger than the rest, but not so much so as in the last species; all remaining distinct from each other nearly to the point of the pinna, although sometimes so crowded as to overlap. Leaf-stalk clothed with pinnæ to its base, and very scaly. Sori distinct, brown, small. Indusium orbicular, fixed by its centre, soon withering.

This plant varies much in the sharper or blunter shape of the lobes of the leaves, for which reason it is sometimes extremely difficult to decide if a leaf be of this species or the former. Luxuriant plants assume much the appearance of *lobatum*, as the large pinnules become slightly decurrent; but in this state they become somewhat deeply cut, or even compound, while in the last species they are truly entire, losing their serratures instead of becoming more cleft by culture.

β. Pinnules short, blunt, thin, and membranaceous, distinctly auricled. Rachis very chaffy. *Aspidium angulare*, Smith in *E. Fl.*, Hook., Mack., Willd. *A. aculeatum* β, Smith, in *Ft. Br.* FIG.—Plate ii, f. 6 β. *E. B. Supp.* 2776.

γ (*linearis*). (*angustatum*, Moore, 1853.) Pinnules linear and very sharp-pointed. FIG.—Plate ii, f. 6 γ.

These are well-marked varieties, yet not sufficiently distinct either in habit or character to constitute separate species. The var. β has, when luxuriant, its lower and larger pinnæ compound (*Polystichum angulare*, var. *subtripinnatum*, Moore, 1853); when it becomes of course subtripinnate, and larger (but not comparatively

aculeatum and *A. angulare* as distinct species, it is necessary that I should state the reasons why I have blended these two plants together. I have not been guided by any desire of innovation, believing unsteadiness of nomenclature and of classification to be the bane of science, but because after the most careful examination of specimens from all parts of Great Britain where they grow, and after consulting all the most celebrated practical botanists that I have the honour to be acquainted with, I have found it absolutely impossible to draw the line of demarcation between the plants. To delineate extreme states of any variable plant is easy enough, but where there is so regular a gradation from the robust pointed pinnules to the blunt and delicate ones, the difficulties of discrimination are insurmountable. Also, upon writing to various gentlemen for specimens and habitats, I have received the same plant repeatedly under the two names, and it is very remarkable that the habitats received invariably refer to both varieties, though they have not always been received from the same person. Thus Dr. Johnston says, that both grow at Peasebridge, Berwickshire; Mr. Bowman says of *Aculeatum*, near Richmond, Yorkshire; while Mr. J. Tatham notes the same place as a station for the *Angulare*. Thus doubts arise if the same or different plants are indicated. The name *Angulare* appears, however, by far the more commonly given to it, and I should for this reason have preferred it to *Aculeatum*, in deference to the opinion of my countrymen; but foreigners give the name *Angulare* to an Hungarian Fern very different from ours, and as *Aculeatum* is the specific name of all authors who have combined the two Ferns, and is besides more expressive, I have adopted it.

more robust), thereby differing from the first or normal state of the plant, which alone approaches the last species in occasionally decurrent and convex pinnules.

SIT.—Common in hedgerows, damp banks, &c., chiefly in the South.

HAB.—Scot.: Peasebridge, *Dr. Johnston*.—Eng.: Near Richmond, Yorks., *Mr. J. Tatham*. Burton Wood, near Warrington, Lane., and in Cheshire, *Mr. Rylands*. Ulverscroft Priory, Charnwood Forest, *Rev. A. Bloxam*. Isle of Man, *Mr. Forbes*. Derbyshire, *Dr. Howitt*. Warwickshire, *Rev. W. T. Bree*. Somerset, *Mr. A. Southy*. Little Worley Common, Essex, *Mr. R. Castles*. About Tunbridge Wells and elsewhere, Kent (abundant), and near Bramshot, Hants, *Mr. W. Pamplin*. Osterley Park, Lampton Lane, and Sion Lane, near Brentford, Midd., *Mr. J. Bevis*. Near Hastings, *Mr. W. C. Trevelyan*. Sussex, *Rev. G. E. Smith*. Kingsteignton, *Mr. Anderson*. Near Gurnet Bay, Isle of Wight, *Prof. Henslow*.—WALES: Near Wrexham, Denbighs., *Mr. J. E. Bowman*. Ciekle, near Beaumaris, Anglesea, *Mr. W. Leighton*. Near Bangor and Caernarvon, *Mr. W. Wilson*.—IRE.: Colin Glen, Belfast, *Mr. Mackay*. Hedge-banks near Carriekfergus, *Mr. F. Whittle*. β . Intermixed with, and even more common in the extreme south of the kingdom than the first state of the plant. γ . Near Clonmel, *Mr. G. S. Gough*.

GEO.—Europe generally; Arabia; Cape of Good Hope, North Africa; on the Green Mountains, Vermont, and other places in North America.

B. LASTRÆA.—*Indusium roundly kidney-shaped, fixed by the notch.*

4.—ASPIDIUM THELYPTERIS.

MARSH SHIELD-FERN.

(Plate III, fig. 1.)

CHA.—Leaf pinnate, erect. Pinnæ linear-lanceolate, pinnatisect, smooth. Segments with a short bristle at the tip. Sori small. Rootstock creeping.

SYN.—*Aspidium Thelypteris*, Swz., Willd., Smith, Hook., Galp., Mack., Pursh.
—*Polypodium Thelypteris*, Lin., E. B., Dicks., Ehrh., With., Lightf. (not of *Huds.*)—*Aerostichum Thelypteris*, Linn., Bolt.—*Athyrium Thelypteris*, Spreng.—*Polystichum Thelypteris*, Roth.—*Lastrea Thelypteris*, Presl., Newm.—*Hemestheum Thelypteris*, Newm., 1854.

FIG.—*Flo. Dan.* t. 760.—*Bolt.* 43, 44.—*Newm.* page 123 (ed. 1854).

DES.—Rootstock creeping, furnished with long, black, slender, rather smooth runners, giving rise at various points along their surface to black radical fibres, and erect, light-green, smooth, ovate, or (when fertile) oblong leaves, each from 6 to 12 inches long, having a slender, and generally smooth stalk. Pinnæ linear-lanceolate, pointed, deeply pinnatisect, stalked, opposite. Segments oblong, obtuse, occasionally with a very small point; the first upper segment on each pinna much longer than the others. Sori in longitudinal lines near the margin of each segment, small, brown or black, at first distant, afterwards confluent. Indusium small, thin, white, round, kidney-shaped, fastened near the centre, and soon lost among the growing thecæ. The barren leaves differ much from those which are fertile; they are altogether wider, shorter, and flatter, with the pinnæ horizontal, and stalk void of pinnæ half way

up. The fertile leaves have two thirds of the stalk covered with pinnæ, which are more numerous, deflexed, and curled, particularly at the point, while the edges of the pinna, folding over the lines of sori, give it an acute appearance.

The only British Fern with which it is possible to confound this is *Aspidium Oreopteris*, from which it differs in its smaller size, lighter colour, more ovate leaf not contracting so much below, the folded segments of the pinnæ, and its creeping rootstock. This last character will distinguish it from all our other species of this genus, it being the only one of which the rootstock is not tufted. It is by no means easily cultivated, nor frequent in fruit when wild, as the fertile leaves do not rise till late in the season. While undergoing the process of desiccation for the herbarium, the elasticity of the annulus of the theca is very apparent, bursting with violence, and scattering the spores in all directions, and to a considerable distance.

HAB.—Common in Scotland, *Sir W. J. Hooker*. Learmouth Bogs, Northumb., *Mr. Wineh.* Near Settle, Yorks., *Mr. J. Tatham*. Allesley, Warw., *Rev. W. Bree*. Knutsford Moor and New Church Bog, near Over, Cheshire, *Mr. W. Wilson*. Oxtou Bogs, Notts, *Dr. Howitt*. Windsor Park and Sunning Hill Wells, Berks, *Mr. J. Beris*. Valley below Caesar's camp, on Wimbledon Common, planted there some years ago by Mr. Tyton. Bog on Waterdown Forest, near Tunbridge Wells (1835), *Mr. Pamplin*. Somersets., *Mr. Southby*. Belton, Suffolk, *Mr. Paget*. Sussex, *Mr. Borrer*. Border of lake near Red Wharf, Anglesea, *Mr. W. Wilson*. Beaumaris, Anglesea, *Mr. J. Bowman*. Marshes at Glenree, county of Wicklow, and Muernuss, Killarney, *Mr. Mackay*.

GEO.—Pomerania, Mecklenburg, Prussia, Denmark, Sweden, North and South Africa, and in all the United States, but seldom with fruit.

5.—*ASPIDIUM OREOPTERIS*.

HEATH SHIELD-FERN.

(Plate III, fig. 2.)

CHA.—Leaf pinnate, lanceolate, much attenuated below. Pinnæ glandular, deeply pinnatisect. Segments blunt, entire. Rootstock tufted.

SYN.—*Aspidium Oreopteris*, Swz., *Willd.*, *Smith.*, *Hook.*, *Galp.*, *Spreng.*, *Mack.*, *Schuk.*—*Aspidium odoriferum*, Gray.—*Polypodium Oreopteris*, *Ehrh.*, *Dicks.*, *With.*, *Hutt.*, *Sibth.*, *Hoffm.*, *Link.*—*Polypodium Thelypteris*, *Huds.*, *Bolt.*, *Lightf.*, *Hedw.*—*Polystichum montanum*, *Decan.*—*Lastræa Oreopteris*, *Prest.*, *Newm.*—*Lastræa montana*, *Newm.*, 1854.

FIG.—*E. B.* 1019.—*Flo. Dan.* 1121.—*Bolt.* 22, f. 1 and 2.

DES.—Rootstock tufted, large, black, scaly, fibrous. Leaves several, growing in a circle from a crown, finely lanceolate, tapering at both ends. Leaf-stalk covered with fine hair on the upper part, and with a few scattered scales on the lower, delicate green, with a deep channel on the upper side. Pinnæ extending nearly all along the stalk, more or less alternate, sessile, deeply pinnatisect, tapering to

a fine point, on the upper side smooth, on the under side hairy, particularly about the main rib, and covered with yellowish, shining glands, smelling of turpentine. Segments very numerous, flat, blunt, and entire. Sori marginal, at length confluent, covering all the pinnæ. Indusium thin, white, kidney-shaped, soon shrivelling up.

The fresh plant may instantly be known from all its congeners by the smell emitted when drawn through the hand, or by holding it up to the light, in which situation it shows very plainly transuecent, minute points, very similar to those seen in *Hypericum perforatum*; though, be it observed, that unfavorable situation and cold weather will often prevent the formation of, if not obliterate these odorous pores. They are most abundant when the plants grow in sunny, but not too dry localities. This Fern can only be mistaken for *Asp. Thel.* or *Asp. Fil.-mas.* It has already been distinguished from the former in describing that plant; from the latter it may easily be known by its more elegant shape, its smaller size and more delicate structure, no less than by its greater smoothness in every part, particularly its rachis. The segments of the pinnæ also are not crenate, as in *Filix-mas*; and the sori, which in that are large, distinct, and confined to the lower half of the segment, are in this plant small, closer together, more numerous, and continued throughout the whole length of the segment, very near the margin.

SIT.—On heaths and in shady lanes, not uncommon in the North.

HAB.—SCOT.: Glen Isla, Forfarsh., *Mr. W. Brand.* Common in Sutherland, *Dr. Johnston.* Banks of Loch Tay, *Mr. T. H. Cooper.* Aberdeenshire, but not common, *Dr. Murray.* Foot of Craig Chailleach, &c., *Mr. W. Wilson.*—ENG.: Near Chapel Weardale, Durham; and Cawsey Dean, near Newcastle, *Mr. R. B. Bowman.* Keswick, and near Lodore Waterfall, Cumbl., *Mr. H. C. Watson.* By the Tees, *Mr. J. Hogg.* Near Richmond, Yorks., *Mr. J. Ward.* Coleshill Heath and Corley, Warw., *Rev. W. Bree.* Near Warrington, *Mr. W. Wilson.* Dethick Moor, and near Riley, Derbys., *Dr. Howitt.* Isle of Man, *Mr. Forbes.* Dallington Heath, near Northampton, *Mr. Anderson.* N. side of Shotover Hill, Oxfordsh., *Mr. Baxter.* Oxtou and Eddingley Bogs, Notts; and Hartswell, near Farnsfield, *Mr. T. H. Cooper.* Somerset, *Mr. A. Southby.* Bradwell, Suffolk, *Mr. Turner.* Sussex and Kent, *Rev. G. E. Smith.* Bailey's Hill, between Brasted and Tunbridge (1835), *Mr. Pamplin.*—WALES: Near Wrexham, Denbighshire, *Mr. J. E. Bowman.* Llanberris and Nant Gwynedd, Caernarvonsh., *Mr. C. C. Babington.* Frequent in Caernarvonsh., *Mr. W. Wilson.*—IRE.: Powerseourt Deer Park and Waterfall, Mangerton Mountain, *Dr. Osborne.* Lough Corril, Galway, *Mr. Shuttleworth.* Plentiful in Ireland, *Mr. Mackay.*

GEO.—Germany, Italy, Switzerland, Prussia, &c.

6.—ASPIDIUM FILIX-MAS.

MALE FERN.

(Plate III, fig. 3.)

CHA.—Leaf pinnate or almost bipinnate, broadly lanceolate. Pinnæ alternate, very deeply pinnatisect. Segments obtuse, crenate. Sori near the central vein.

SYN.—*Aspidium Filix-mas*, Swz., Willd., Smith, Hook., Galp., Mack.—Poly-

podium Filix-mas, *Linn.*, *Huds.*, *Bolt.*, *Woodv.*, *Dicks.*, *Ehrh.*, *Ger.*, *With.*, *Lightf.*—*Polystichum* Filix-mas, *Roth.*, *Decan.*—*Polystichum* Callipteris, *Bernh.*—*Lastræa* Filix-mas, *Presl.*, *Newm.*

FIG.—*E. B.* 1458.—*Bolt.* 24.—*Woodv.* 49.—*Flo. Lon.* 40.—*Newm.* (1854), 183.—*Moore* (1853), p. 104.

DES.—Rootstock large, tufted, black, and sealy. Leaves growing centrally from a crown, broadly lanceolate, pinnate. Pinnæ lanceolate, pointed, alternate, smooth, except on the under side of the midrib, of a bright green, regularly tapering, curved upwards, and so deeply cleft as to appear pinnate at first sight. Segments oblong, obtuse, slightly crenate at the sides, copiously at the end, very close together, but not overlapping each other. Sori confined to the upper half of the leaf, and to the lower half of each segment of the pinnæ, situated near the mid-vein, round, large, and very prominent. Indusium large, orbicular, with a notch on one side, at first white and transparent, afterwards opaque, and of a fine reddish-brown, covering the thecæ even till they are fully ripe.

The large size, robust appearance, and decided character of this plant, obtained for it very early and very aptly the name of Male Fern. Medicinal properties of some importance have been ascribed to it, and apparently with justice. It is retained in most of the pharmacopœias of Europe as a specific for the larger kinds of intestinal worms, and used very extensively for that purpose by the faculty on many parts of the Continent, and if the employment of it has been discontinued here, it is not because of its inutility, but from the discovery of other remedies equally potent and better understood. The stem and roots are bitter and astringent, and have been used instead of hops. It is sometimes found with a cornus some inches above the ground; Mr. W. Wilson has seen it thus in Caernarvounshire, and Mr. Mackay in Wicklow. A white and green variegated variety is known. A singular variety, with the upper pinnæ remarkably compound or branched (*var. cristata*, *Moore*), has been observed in Bore-hill Lane, below Dorking, Surrey, by Mr. W. Pamplin. Also Mr. T. Clarke, jun., of Bridgewater, has been so kind as to send me from King's Cliff Valley, four miles from that town, several leaves of a very large variety, which is found there in considerable abundance. It is of a very dark colour, has sori along the whole pinnule, and the pinnules themselves are all deeply serrated along their margin. Mr. Clarke also writes me, that Sir W. J. Hooker confirms his, and I may add, my opinion also, that this plant is a variety of Filix-mas, though Sir William observes that Schkults, who found it near Dresden, looked upon it as a new species, and figured and described it as *A. erosum*. The continental *A. Filix-mas* is usually more crenate or serrate than ours.

β (*erosa*). Bipinnate, pinnules less crowded, more elongate and narrower, incised-toothed. *Lastræa* Filix-mas, *var. incisa*, *Moore*, &c.

Another form is also described:

γ (*abbreviata*). Dwarf, sub-pinnate, segments small and confluent; sori usually only on the anterior venule of each segment.

SIT.—Hedge-banks, &c., and in shady lanes throughout the kingdom.

HAB.—I have received numerous habitats from most of the English and Scottish counties, from the extreme south to the Orkney Islands, and yet in some places this plant is rare. Inchmedamff, in Sutherland, is one of these.—β. This form seems equally common with the type.—γ. Teesdale, Durham, *Mr. J. Backhouse*. Ingleboro', Yorks., and in Cumberland, *Rev. G. Pinder*. Coniston, Lancashire, *Miss Beaver*. Near Llyn Ogwen, Caernarvonsh., *Mr. S. O. Gray*.

GEO.—North America, throughout Europe, and in Africa.

7.—ASPIDIUM CRISTATUM.

CRESTED SHIELD-FERN.

(Plate III, fig. 4.)

CHA.—Leaf linear-lanceolate, pinnate. Pinnæ opposite, cordate, attenuated, deeply pinnatisect, but scarcely pinnate. Segments ovate, decurrent, crenate, and with crenations serrate, and with bristled teeth.

SYN.—*Aspidium cristatum*, *Suz.*, *Willd.*, *Smith*, *Hook.*, *Spreng.*, *Galp.*, *Mack.*, *Schk.*, *Pursh.*—*Polypodium cristatum*, *Linn.*, *Afzel in Stochh. Trans. for 1787.*—(Not. of *Bolt.*, *With.*, or *Huds.*) *Polystichum cristatum*, *Roth.*, *Decan.*, *Hoffm.*—*Polypodium Callipteris*, *Ehrh.*, *Hoffm.*—*Lastrea cristata*, *Presl*, *Newm.*—*Lophodinn Callipteris*, *Newm.* 1854.

FIG.—*Hook. in Flo. Lon. new ser.* 113.—*E. B.* 2125 (not 1949).—*Newm. page* 89 (1854).—*Moore* (1853), p. 166, 117.

DES.—Rootstock tufted. Leaves erect, rigid, yellowish-green, pinnate, oblong, blunt. Pinnæ opposite, eight to fourteen pairs, very distant from each other, short, ovate, oblong, obtuse, very deeply pinnatisect or rather pinnate at their lower part. Segments ovate, crenate, each crenature furnished with two or three small sharp points, or bristles, the principal vein in each segment slightly crooked, but the midrib of the whole pinna straight. Leaf-stalk slightly scaly only towards the lower part, where for about one third of its height it is otherwise naked. Sori large, very distinct, black at first, afterwards brown. Indusium white when young, very thick, circular, with a lateral notch, and fixed by the centre.

Few plants have occasioned more discussion than this. The difficulty has arisen chiefly because sufficient stress has not been laid upon the simply pinnate character of the leaf; had this been regarded more, *Aspidium spinulosum* would not so often have been confounded with it. The *cristatum*, besides being less divided, has a more obtuse, more linear leaf, and contracts very much, below. The sori of *cristatum* are comparatively much larger and less numerous and their indusia persistent, not hidden by the capsules. It very nearly resembles the American *Aspidium Goldianum*.

HAB.—This is one of the rarest Ferns, not only here but on the Continent. The only recorded habitats of it in this country, were the Lows, in Holt Heath, Norfolk, *Rev. R. B. Francis*. On bogs among alder bushes, at Westleton, Suffolk, *Mr. Davy*. Oxton Bogs, Notts, *Dr. Howitt* and *Mr. T. Cooper*. But it has been lately discovered in various other parts of Suffolk and Norfolk, and also in Staffordshire and Cheshire. One of these habitats may, perhaps, be now expunged, as *Mr. Dennes* informs me it is thirty years since it was last found at the Lows in Holt Heath. It was stated on page 70, of the first edition, that I had reason to believe that this plant grew on Wimbleton Common; this was an error of judgment or of memory in my informant. It does not grow there, but the *A. spinulosum* does. *Mr. Mackay* admits it into the Irish Flora, as growing in the grounds of Viscount Gough, at Rathronan, near Clonmel, found there by *Mr. G. S. Gough*, in 1835; he says that the Irish plant is acutely serrate.

GEO.—Oldenburgh, Bremen, Mecklenburgh, Hanover, and other parts of Germany. New York to Virginia.

8.—ASPIDIUM RIGIDUM.

RIGID SHIELD-FERN.

(Plate III, fig. 5.)

CHA.—Leaf lanceolate, bipinnate. Pinnæ alternate. Pinnules narrow, oblong, obtuse, slightly pinnatifid. Segments broad, with 2 to 5 (mostly 3) teeth, without bristles. Leaf-stalk scaly.

SYN.—*Aspidium rigidum*, *Hook. in Bri. Flo., ed. 3 and 4, Swz., Schk.*—*Aspidium spinulosum*, *Hook. in Bri. Flo., ed. 1.*—*Polypodium rigidum*, *Hoffm.*—*Polystichum rigidum*, *Deean.*—*Polystichum strigosum*, *Roth.*—*Lastræa rigida*, *Prest, Newm.*—*Lophodium rigidum*, *Newm.* 1854.

FIG.—*E. B. Supp.* 2724.—*Schk. fil. t. 38.*—*Newm. page 175 (1854), Moore, 112 (1853).*

DES.—Rootstock tufted. Leaf-stalk thick, rigid, very scaly all the way up. Leaf lanceolate, not contracted below, erect, from one to two feet high. Pinnæ tapering, alternate, very close together, from thirty to forty pairs, their stalks very much thickened at their union with the main stalk. Pinnules distinct, decurrent, oblong, blunt, slightly pinnatifid, with the segments obtuse, mostly tridentate, but *not spinulose*, their midrib waved. Sori large and abundant, chiefly on the upper part of the frond. Indusium round, reniform, persistent, with a glandular margin, white at first, lead-coloured afterwards, covering the whole mass of thecæ, &c.

Much diversity of opinion has existed respecting the identity of this very distinct plant, a small state of the *spinulosum* being very often sent for it. Its generally *alternate* pinnæ would be perhaps sufficient to distinguish the two, but in other respects it differs essentially from that more common species. The leaf-stalk of the *rigidum* is very scaly and very much thicker than in the *spinulosum*, its pinnæ much more numerous and nearer together, the lower pair not broader than the rest, the pinnules of all quite decurrent, and not by any means spinulose, besides which the indusia are very large, and so different, as at once to distinguish the two plants; in addition to which it may be remarked, that *Aspidium rigidum*

is much darker in colour than the spinulosum, as it is also than the cristatum. It is intermediate between the last and next species in the number of its divisions, but does not resemble either of them in habit or appearance. Mr. Newman and the late Professor Don both support me in the identity of this species with the *Aspidium rigidum* of Sehkuhr, specimens from whom I have seen. Mr. Newman justly remarks that, "when cultivated, it assumes a more diffuse and lax appearance, and is not so like Sehkuhr's figure as the plant from Settle."

HAB.—Found by *Rev. W. Bree*, in 1815, on Ingleborough, on a natural platform, near the foot of the mountain, and towards the neighbouring village. This was, I believe, the only situation recorded for this fern, at the publication of my first edition in 1837. Since then it has been sought after and found in three or four places, considerably distant from each other; and there is reason to suppose that it is pretty generally distributed all over the Ingleborough range, towards the foot of the hills. Thus *Mr. W. Wilson* finds it at Wharfedale. *Mr. Chorley* has kindly communicated to me specimens from near Settle, where he and *Mr. J. Tatham* find it abundantly. Also other leaves of the true plant have reached me from *Miss Beever*, a young and enthusiastic botanist, who finds it at Arncliffe Knot, not far from Silverdale.

GEO.—Switzerland, Prussia, Germany, &c.

9.—ASPIDIUM SPINULOSUM.

PRICKLY SHIELD-FERN.

(Plate III, fig. 6.)

CHA.—Leaf bipinnate. Pinnules opposite, pinnatisect, the segments almost separate in the lower part, spinulose. Leaf-stalk nearly smooth, white, with few ovate membranous scales.

SYN.—*Aspidium spinulosum*, Willd.—*Polypodium spinulosum*, Swz., Retz.—*Polypodium cristatum*, Hoffm., Schreb.—*Polypodium spinosum*, Schr.—*Polypodium dentatum*, Moench.—*Aspidium spinulosum* α, Hook. and Arnott.—*Lophodium spinosum*, Newm. 1854.

FIG.—*E. B.* 1460.—*Flo. Dan.* 707.—*Phuk. Phyt.* 181, f. 2 (a young plant).—*Schk. Fil.* 48.

DES.—Leaf ovate or oblong, always erect and flat. Pinnæ very nearly opposite, smooth, and distinct, as are also the pinnules, which are rarely convex. Segments oblong, pointed, deeply serrate, and spinulose. Leaf-stalk nearly smooth, swollen at its ramifications, of a whitish colour, and generally covered with black dots; with few ovate membranous scales. Sori scattered, small. Indusium small, brown, soon shrivelling up.

This plant goes by various names among British botanists. It is repeatedly considered and sent as *Aspidium cristatum* (which see, page 39), and is such of some authors, but not of Smith, Hooker, or MacKay. It is also confounded with the much rarer *Aspidium rigidum*, the diagnostics of which are very distinct; and with the next species, *Aspidium dilatatum*, it is often considered identical, though sufficiently different, both wild and cultivated, in habit, texture, and colour. Our present plant is narrower than the *dilatatum*, of a less number of pinnæ, flat, erect, rigid in habit, of a very light green colour, the midrib of the pinnules more

zigzag and prominent, the lower pinnae rarely twice pinnate, the indusium glandular, and the whole plant much more delicate.

It should be observed that the above remarks are not intended to apply to that plant which Sir J. E. Smith's herbarium contains, and which Sir W. J. Hooker describes as a variety of *dilatatum*, under the above name. The spinulosum of northern botanists, of Sir J. E. Smith, and of the Liverpool Botanic Garden, is, in reality, but a variety of the next, and closely approaches to the recurvum of Bree, and dumetorum of Smith, if not identical with them. The plant here intended to be described is altogether different, and in cultivation retains precisely the character of the wild plant, never approaching in the most remote degree the *Aspidium dilatatum*, though the mountain form of this latter plant has the lower pinnae much abbreviated.

In a variety of spinulosum given me by Mr. J. Merriek, of Manchester, the lobes on the *upper* side of each pinna are much larger than those on the lower; also, it may be remarked, that in dry situations the pinnules will become convex, but this is by no means common.

STR.—On wet moors, sides of pools and ponds, wet hedgerows, &c.

HAB.—SCOT.: Moray and Ross-shire, *Rev. G. Gordon*. Aberdeenshire, *Dr. Murray*. Dumbartonshire, *Mr. J. Hooker*. Auchindenny Woods, Edinburgh, *Mr. Watson*.—ENG.: Isle of Man, *Mr. Forbes*. Near Richmond, Yorks., *Mr. J. Ward*. Ingleborough, Yorkshire, *Rev. W. Bree*. In a small state at Woolston Moss, Lane., and Newchurch Bog, near Over, Cheshire, *Mr. W. Wilson*. Titterstone Clee Hills, Shrops., *Mr. J. S. Bayly*. Bomere Pool, Salop, *Mr. C. Babington*. Warwicksh., *Rev. W. S. Bree*. Derbys., *Dr. Howitt*. Pottery Car, near Doncaster, *Mr. S. Appleby*. Dallington Heath, near Northampton, *Mr. Anderson*. Norfolk, *Miss Bett*. Near the Windmill, and near the Spring-well, on Wimbleton Common, *Mr. W. Pamplin*. Barnes Common, Surrey (near the Water-house), *Mr. Castles*. Abundant in Essex, *Mr. J. Bevis*. Common in Kent, *Mr. W. Pamplin*. Tynbridge, Kent, *Mr. W. C. Trevelyan*. Sussex and S. Kent, *Rev. G. E. Smith*. Wood near Dunsford Bridge, Devon, *Mr. Jacob*. Near Torquay, *Dr. Greville*.—WALES: Aber., Caern., *Mr. Leighton*. Near Wrexham, Denb., *Mr. J. E. Bowman*. Note.—I cannot say whether the Scotch and Welsh habitats refer to the above plant, or to the spinulosum of the Br. Fl.

GEO.—Switzerland, Dauphiny, Salzburg, Darmstadt, and North America.

10.—ASPIDIUM DILATATUM.

GREAT SHIELD-FERN. DILATED SHIELD-FERN.

(Plate III, fig. 7.)

CHA.—Leaf tripinnate, triangular. Pinnæ opposite, segments deeply dentate, spinulose, petioled. Leaf-stalk scaly.

SYN.—*Aspidium dilatatum*, Willd., Spreng., Forst., Galp., Gray.—*Aspidium spinulosum*, Swz., Sibth., Mack., Schk.—*Aspidium spinulosum* β , Hook. and Arnott.—*Polypodium cristatum*, With., Bott., Huds., Ehrh., Moench., Lightf.—*Polypodium dilatatum*, Hoffm., Mutt.—*Polystichum multiflorum*, Roth.—*Lastrea dilatata*, Presl, Newm.—*Lophodium multiflorum*, Newm. 1854.

FIG.—E. B. 1461.—Bott. 23.—Schk. Fil. 47.—Newm. p. 59, 61.

DES.—Rootstock black, tufted. Leaf tripinnate, triangular, from a few inches to 2 feet high, dark green, and drooping. Pinnæ

opposite, smooth, oblong, obtuse, pinnate, except the lower pair, which are doubly pinnate. Pinnules ovate, pointed, convex, deeply but irregularly serrated and spinulose, petioled, their midribs straight. Leaf-stalk long, covered with brown scales, with a blackish middle, Sori all the summer, distinct. Indusia soon becoming obliterated, round, with a lateral notch.

A very variable plant, altered much by cultivation and circumstances; thus if it grow in a situation which is wet in the spring and dried up in the summer, as on the margin of a pond, it will become var. β , very dark, large, and quite drooping. Continued wet will elongate the leaf and separate the pinnæ and pinnules as in var. γ . A young plant is only twice pinnate and flat. A dry and rocky, or a confined situation will render the leaf small and less divided, the pinnules blunt, deflexed, and drooping: thus starved it becomes the *Aspidium dumetorum* of Smith (var. δ). I know not the nature of the habitats in which the recurved var. (ϵ) of Bree grows. [It is said to grow both in dry and wet shady places, preferring moisture. But all the recorded localities are in damp climates.—ED.] The varieties *recurvum* and *dumetorum* are, I believe, not altered by cultivation, and Sir J. E. Smith implies, in his description of the latter, that its spores produce the same variety.

α (*ditatum*). Frond sub-tripinnate, triangular, ovate. Pinnules petioled.

β (————). Frond tripinnate, deflexed, triangular. Pinnules convex.

γ (————). Frond tripinnate, triangular, elongated. Pinnules somewhat decurrent, and distant from each other.

δ (*dumetorum*). Frond small, triangular, drooping. Pinnules blunt.

ϵ (*recurvum*, Bree). Frond small. Pinnules *concave*, and dark green. *Newm.* p. 61. *Lastræa Fœnisecii*, *Bab.* *Lophodium Fœnisecii*, *Newm.* 1854.

SIT. and HAB.— α , β , γ : Very common in damp hedgerows and swampy woods, ascending to an elevation of 1000 yards in many parts of the Highlands, and probably even to 1200 yards on the Cairngorum range, *Mr. H. C. Watson*.— δ : Derbyshire (rare), *Mr. J. E. Bowman* and *Dr. Howitt* Common about Settle, Yorks., *Mr. J. Tatham*. Black Rock, Cromford, Derby., *G. F. Ben-na-Bourd*, Aberdeensh., *Mr. H. C. Watson*. Powerscourt Waterfall, and side of Djouce Mountain, Ireland (abundant), *Mr. Mackay*.— ϵ : Plentiful about Penzance, Cornwall, *Rev. W. Bree*. Western counties of England and in Ireland.

GEO.—Common throughout Europe, and from Pennsylvania to Virginia. ϵ : Plentiful in Madeira and the Azores.

ASPLENIUM, Linn. SPLEENWORT.

(*Ἀσπληγρον*, a medicine to cure disorders of the spleen, from α and *σπλην*.)



A, part of the leaf of *Asplenium marinum*. One pinnule, showing the veins and origin of the fruit, the others the sori in different states. B, part of a

pinnule magnified. C, the same cut transversely. D, lower epidermis. E, transverse section of the leaf-stalk. F, indusium. G, theca and spores. H, young plant.

Sori linear at first, afterwards oblong; indusium linear, attached to a transverse vein, and opening on the opposite part of the sorus towards the central nerve of the pinna. This is a well-marked and extensive genus, of which Sprengel enumerates no less than 151 species; of these ten only are British, which are very little or not at all altered by culture, they are therefore less liable to run into varieties than some other genera. It is only when the sori are in a young state that many species can be known to belong to this genus, as the indusia are so delicate that they are soon lost among the sori, which in many of the smaller species at last appear like round or oblong spols.

1.—ASPLENIUM SEPTENTRIONALE.

FORKED SPLEENWORT.

(Plate IV, fig. 1.)

CHA.—Leaf linear, simple, bi- or tri-partite. Segments linear, sharply toothed at their extremity.

SYN.—*Asplenium septentrionale*, Swz., Willd., Hull, Hoffm., Hook., Smith, Galp., Gray.—*Aerostichum septentrionale*, Linn., Boll., Dicks., Ehrh., With., Huds., Lightf.—*Scolopendrium septentrionale*, Roth.—*Amesium septentrionale*, Newm. 1854.

FIG.—*E. B.* 1017.—*Flo. Dan.* 60.—*Bolt.* 8.—*Flo. Lon.* 162.—*Ger.* 1561.—*Newm. p.* 265 (1854).

DES.—Leaves very numerous, upright when young, drooping afterwards, rigid, 1 to 3 inches high, simple or cleft near the top into two or three linear sharp-pointed alternate segments, which in proportion to their size are furnished at or near their extremity with from one to three acute, but not spinous teeth. Sori one on each side of the segment, nearly longitudinal, concealed at first by a white indusium, attached at the outer edge; afterwards the swelling sori throw back the indusia, covering the whole of the segment, and finally curving and contorting it in a curious manner.

Mr. H. C. Watson writes thus: "Although quite a northern Fern, I observed the young fronds destroyed by a frost of 25 degrees Fahr., in April 1835. The plant had been under a glass in a cold frame during winter, where the temperature inside had risen a few degrees higher than outside by day, and had never been allowed to sink to the freezing point at night, in consequence of a thick covering of mats."

SIT.—On the rocky clefts of mountains, chiefly in the north. Not in Ireland.

HAB.—ENG.: In situations probably exceeding 1000 feet in height in Cumberland, where it occurs sparingly on rocks, between the vale of Newlands and Borrowdale.—WALES: Craig Dhw (a mile above Llanberris Church), Caern., Mr. C. C. Babington. Snowdon (rare), Mr. J. E. Bowman. Llyn-y-cwm, N. Wales, Mr. W. Wilson.—SCOT.: Arthur's Seat, Edinburgh (above the railroad), Jedburgh, &c., Mr. H. C. Watson. Blackford Hill, Edin., Mr. W. Brand.

GEO.—Holland, Switzerland. Not unfrequent throughout Europe.

2.—ASPLENIUM ALTERNIFOLIUM.

ALTERNATE-LEAVED SPLEENWORT.

(Plate IV, fig. 2.)

CHA.—Leaf pinnate. Pinnæ alternate, wedge-shaped, notched or trifid.

SYN.—*Asplenium alternifolium*, *Smith, Hook., Dicks., With., Galp., Jacq.*,
—*Asplenium germanicum*, *Willd., Hoffm., Ehrh., Lam., Weis., Gray, Bab.,*
Moore.—*Phyllitis heterophylla*, *Moench.*—*Scolopendrium alternifolium*,
Roth.—*Asplenium Breynii*, *Retz.*—*Amesium germanicum*, *Newm.* 1854.

FIG.—*E. B.* 2258.—*Jacq. Misc. t. 5, f. 2.*—*Breyn. Cent. 1, t. 91.*—*Newm.*
p. 258 (1854).

DES.—Leaf from 1 to 3 inches high, very light green, upright, delicate, about half covered with pinnæ, which are alternate and wedge-shaped; the larger partly three-cleft, the smaller bluntly notched at the end only. Leaf-stalk dark at the base only. Sori two to four on each pinna, small, light brown, becoming confluent, but not occupying the whole under surface. Indusium entire on the margin.

This species is intermediate between the last and *Asplenium Ruta-muraria*, although of a more delicate and erect habit than either; its colour also is much lighter, and its sori smaller and less confluent. When once seen it cannot possibly be mistaken for any of the numerous casual forms of *Asplenium Ruta-muraria*.

The plants sold under this name in the nurseries around London are the true species derived from some plants brought wild from Scotland, about fourteen years ago, and given to the Countess de Vande, at Bayswater, and from her garden distributed around. It quite retains its character in cultivation.

HAB.—Found originally by Mr. Dickson on rocks in the south of Scotland, two miles from Kelso, on the Tweed. Now existing at Dunkeld, in Perthshire, Mr. Bishop and Dr. Macnab. Very sparingly near Dunfermline, Fifeshire, Dr. Dewar.

GEO.—Germany, Sweden, and Switzerland, where it is quite an alpine plant.

3.—ASPLENIUM RUTA-MURARIA.

WALL RUE. RUE-LEAVED SPLEENWORT. TENTWORT.

(Plate IV, fig. 3.)

CHA.—Leaf bipinnate. Pinnæ alternate. Pinnules ovate or wedge-shaped, with rounded notched extremities.

SYN.—*Asplenium Ruta-muraria*, *Linn., Willd., Hook., Smith, Bolt., Bull.,*
Ehrh., Huds., With., Galp., Lightf.—*Asplenium murale*, *Bernh., Gray.*—
Scolopendrium Ruta-muraria, *Roth.*—*Phyllitis Ruta-muraria*, *Moench.*—
Ruta-muraria, *Bau., Ray, Ger., Plum., Newm.*

FIG.—*E. B.* 150.—*Bolt. 16.*—*Fl. Dan. 190.*—*Bull. Fr. 195.*—*Plum. Fil.*
t. A, f. 3.—*Newm. Brit. Ferns, p. 253* (1854).

DES.—Rootstock tufted, black, very long. Leaf from 1 to 4 inches

high, dull green. Leaf-stalk green, except at the very base. Pinnæ confined to the upper half, from three to five or six in number, placed alternately, for the most part distinctly three-cleft. Pinnules ovate in small fronds, wedge-shaped in the larger; their tips rounded and erenate, or unequally notched. Barren leaves broader and shorter. Sori dark brown, finally confluent, and covering the whole under surface. Indusium uneven at the margin.

SIT.—On walls, ruins, rocks, and other similar situations.

HAB.—Very generally distributed over the United Kingdom, though there are a few districts where it is scarcely found. I believe Berwickshire is one of these, nor is it by any means plentiful in Norfolk or Suffolk.

GEO.—Most parts of Europe; and from New York to Carolina, in America.

4.—ASPLENIUM MARINUM.

SEA SPLEENWORT.

(Plate IV, fig. 4.)

CHA.—Leaf linear-oblong, pinnate. Pinnæ obtuse, serrate, slightly auricled above. Leaf-stalk winged.

SYN.—*Asplenium marinum*, Linn., Willd., Huds., Bolt., Dicks., Lightf., With., Galp., Smith, Hook., Mack., Gray, Newm., &c.

FIG.—*E. B.* 392.—*Lob. Ic.* 814.—*Fl. Lon.* 60.—*Bolt.* 15.—*Ger.* 1143.—*Newm.* 235 (1854).

DES.—Rootstock very thickly tufted, black, with stout fibres. Leaf 6 to 9 inches high, pinnate, irregularly oblong, obtuse. Leaf-stalk winged all the way down, black, shining, smooth, without pinnæ at the lower part, above bearing from ten to twenty on each side, mostly alternate, obtuse, about an inch long in the middle of the frond, running at the base into the wing of the stalk, therefore slightly decurrent; the upper side of each generally auricled, the lower side proportionably truncate. Sori large, transverse, at first linear, then oblong, but never confluent. Indusium white, or of a pale brown.

SIT.—Upon maritime rocks, or in caves by the sea-side, and in one or two inland situations.

HAB.—ENG.: Marsden Rocks, Durham, *Mr. R. B. Bowman*. Isle of Man, *Mr. Forbes*. Above the Black Rocks at the entrance of the Mersey (Cheshire side), *Mr. H. C. Watson*. Liverpool (near the Dingle), *Mr. Merrick*. Still at Hulme Stone Quarry (otherwise called Winwick Stone Delph), near Warrington, where Bolton gathered it (*v. Bolt. Fil. loc. cit.*), *Mr. W. Wilson*. In this place *Mr. Shaw*, of Bollington, many years ago found a curious variety, with a much more divided frond than is usual, and which remains with him distinct in culture. Sussex, *Mr. Borrer*. West of Cornwall, *Professor Henslow*.—WALES: Anglesea, *Mr. J. E. Bowman*. Near the South Stack Lighthouse, Holyhead, *Mr. C. C. Babington*. Ormeshead, and near Bangor, *Mr. W. Wilson*.—SCOT.: Parish of Nigg, Ross-shire, *Mr. Brichan*. Near Port Patrick, Wigtonshire, *Dr. Balfour*. Moray, *Rev. G. Gordon*. Isle of Staffa, *Mr. J. Doraston*. Near Eyemouth,

Berwickshire, *Rev. A. Baird*. Frequent on the whole line of the Berwickshire coast, *Dr. G. Johnston*. Fifeshire and Aberdeenshire (common), *Dr. Murray*. Isle of Arran, *Mr. T. H. Cooper*.—IRE.: Sutton side of Howth Mountain, Underwood, Killiney Hill, &c., *Dr. Osborne*. Derrinane, county Kerry, *Mr. Kelly*. Abundant on the southern and western coasts, *Mr. Mackay*.

GEO.—Barbary, Canary Islands, Spain, St. Helena, West Indies, Islands of the Archipelago, &c. There is but little difference between our plant and *Dr. Hooker's* species *Asplenium obtusatum*.

5.—ASPLENIUM TRICHOMANES.

COMMON MAIDEN-HAIR SPLEENWORT. WALL SPLEENWORT.

(Plate IV, fig. 5.)

CHA.—Leaf linear, pinnate. Pinnæ subrotund, erenate. Leaf-stalk black.

SYN.—*Asplenium Trichomanes*, *Linn.*, *Willd.*, *Michx.*, *Woodw.*, *Bott.*, *Dicks.*, *Ehrh.*, *Lightf.*, *Smith*, *Hook*, *With.*, *Spreng.*, *Huds.*—*Asplenium saxatile*, *Salisb.*, *Gray.*—*Asplenium trichomanoides*, *Schkr.* (*not Michx.*)—*Asplenium melanocaulon*, *Willd.*, *Pursh.*—*Trichomanes*, *Ray*, *Fuchs.*, *Tillands.*, *Bauh.*, *Plum.*, *Park.*—*Phyllitis rotundifolia*, *Moench.*, *Newm.*

FIG.—*E. B.* 576.—*Flo. Lon.* 156.—*Bott.* 13.—*Flo. Dan.* 119.—*Woodw.* 201.—*Ger.* 1146.—*Plum. t. B. f.* 1.—*Newm. p.* 219 (1854).

DES.—Leaves tufted, linear, pinnate, 2 to 4 inches high, dark green, very rigid, quite smooth, with a purplish-black shining stalk, channeled in front. Pinnæ from twenty to thirty pairs, opposite or alternate (generally the former), obtuse, erenate, of a round or oval form, very distinct from each other all the way up, and sessile, or very nearly so. Sori two to six on each pinna, placed transversely, very dark coloured, finally confluent, often covering the whole under surface.

HAB.—Common on rocks, old walls, &c., in most parts of the United Kingdom; not only on the main land, but the Isles of Anglesea, Man, Wight, Shetpy, and the Channel Isles, yet by no means frequent in the N. and N.-E. of Scotland.

GEO.—Throughout Europe. In Jamaica. In Japan and other parts of Asia. Canada, Pennsylvania, and high mountains of Carolina.

6.—ASPLENIUM VIRIDE.

GREEN MAIDEN-HAIR SPLEENWORT. GREEN-RIBBED SPLEENWORT.

(Plate IV, fig. 6.)

CHA.—Leaf linear, pinnate. Pinnæ roundish-deltoid, erenate. Leaf-stalk green.

SYN.—*Asplenium viride*, *Huds.*, *Willd.*, *Roth.*, *Dicks.*, *Ehrh.*, *Bott.*, *Smith*, *Hook.*, *With.*, *Spreng.*, *Galp.*, *Lightf.*, *Gray*, *Newm.*

FIG.—*E. B.* 2257.—*Bott.* 14.—*Flo. Dan.* 1829.—*Pluk. Phy.* 89, f. 6.—*Newm.* 243 (1854).

DES.—Leaves numerous, pinnate, linear, from 3 to 6 inches high, of a very light green colour. Pinnæ petioled, alternate, the upper

ones ovate, the lower roundly triangular, attached to the stalk by the centre of one of the sides, which is somewhat truncate, the other two sides being regularly and deeply crenate, sometimes doubly so. Leaf-stalk quite green, except at the lower part. Sori reddish-brown, two to six on each pinna, confined to the middle of it, finally becoming confluent, but even then not extending to the margin.

This is immediately distinguished from the last by the lighter colour of all its parts, its less-spreading sori, and differently shaped and alternate pinnae; added to which, the pinnae on the lower part of the leaf are generally distant, and those near the top of the leaf crowded, while the whole is much more delicate and elegant. Sometimes the frond is divided into two, as represented in Bolton, t. 2, f. 3, when it becomes the *Trichomanes ramosum* of authors; but this branching is an accidental circumstance, and by no means constant; it therefore does not constitute a variety, more especially as not more than two or three branched leaves are found upon a plant, all the rest being of the common character and appearance.

SIT.—ENG.: On rocks, not farther south than Yorkshire, or perhaps Derbyshire. On rocks in Northumberland, *Mr. Winch*. Mazebeek Sears, Westmorel., and Gordale, Yorkshire, *Mr. R. Bowman*. Near Halifax, Yorkshire, *Mr. R. Leylands*. Near Ais-la-Beek, and Richmond, Yorks., *Mr. J. Ward*. Settle, *Mr. Chorley*.—WALES: Cader Idris, *Mr. J. E. Bowman*. Snowdon, *Mr. C. C. Babington*. Tŵll Du, Caern., *Mr. T. H. Cooper*. Not uncommon on the Welsh mountains, *Mr. W. Wilson*.—SCOT.: Ross-shire, *Rev. G. Gordon*. Cawdor Woods, Nairns, *Mr. W. Staples*. Base of Benmore, Sutherlandsh., *Dr. Johnston*. Far too common in the Highlands to need the specifying of stations, *Mr. H. C. Watson*.—IRE.: Turk Mountain, Killarney; Ben Bulbin, county of Sligo; and on the Donegal Mountains, near Lough Eske, *Mr. Mackay*.

GEO.—Germany, Holland, Switzerland, France; very rare, except on the mountains of Tyrol and Carinthia.

7.—ASPLENIUM FONTANUM.

SMOOTH ROCK SPLEENWORT.

(Plate V, fig. 1.)

CHA.—Leaf linear-lanceolate, bipinnate. Pinnae oblong, blunt, alternate. Pinnules wedge-shaped, cleft into a few large teeth. Leaf-stalk winged.

SYN.—*Asplenium fontanum*, *Hook.*, *Smith.*, *Bernh.*—*Aspidium fontanum*, *Willd.* *Swz.* (*not of Schkr.*)—*Polypodium fontanum*, *Linn.*, *Huds.*, *Bolt.*, *With.*—*Athyrium fontanum*, *Gray*, *Bab.*

FIG.—*E. B.* 2024.—*Lob. Ic.* 810, 1.—*Bolt.* 21 (*bad*).—*Moore* (1853), p. 151.

DES.—Rootstock tufted, long, black. Leaf lanceolate, bipinnate, evergreen, 2 to 6 inches high. Leaf-stalk winged throughout. Pinnae alternate, ovate, oblong, those in the middle of the frond from a quarter to half an inch long, formed of six or eight pinnules placed alternately. Pinnules short, broadly wedge-shaped, petioled, so

very deeply cleft at the sides and toothed at the apex as to become nearly pinnate. Seldom more than two sori upon each pinnule, which soon extend over the whole surface of it.

Our present species most resembles *Asplenium lanceolatum*, the shape of the leaf being nearly the same. The fontanum, however, is much more delicate, and smaller in all its parts, of a very dark green colour, its pinnules not half the size, and of a very different shape to those of the *lanceolatum*, besides which its winged leaf-stalk is of itself a sufficient diagnostic. It is very much more difficult to distinguish it from *Asplenium Halleri*, a species that is very rare on the Continent, and for which our fontanum is very generally sold. [A. *Halleri* is not really distinct.—ED.]

HAB.—This Fern was once found on Amersham Church, in Buckinghamshire, and at Wybourn, in Westmoreland. I have been informed that living plants were found at a waterfall in either Northumberland or Westmoreland, fourteen or sixteen years ago, and also that it once grew on Alnwick Castle; but if so, it is no longer found there. [It has recently been reported from other localities; Matlock, Derbys., *Mr. Shepherd*; Stonehaven, Kincardine, *Mr. Hutcheson*; and specimens exist in the Herb. of the Botan. Soc. of London, marked from Wharfedale Woods, Yorks., *Mr. Redhead* (1838); and Cavehill, Belfast, *Mr. Newnham*.]

GEO.—Saxony, Switzerland, South Europe, and Siberia.

8.—ASPLENIUM LANCEOLATUM.

LANCEOLATE SPLEENWORT.

(Plate V, fig. 2.)

CHA.—Leaf lanceolate, bipinnate. Pinnules obovate, sharply toothed at the apex. Leaf-stalk not winged.

SYN.—*Asplenium lanceolatum*, *Huds.*, *Swz.*, *Hoffm.*, *Willd.*, *Smith*, *Hook.*, *Forst.*, *With.*, *Galp.*, *Gray.*—*Phyllitis lancifolia*, *Moench*.

FIG.—*E. B.* 240.—*Ger. Herb.* 1135.—*Newm. p.* 219 (1854).

DES.—Leaf lanceolate, bipinnate, from 3 to 6 inches high, upright in habit, and of a light green colour. Leaf-stalk green, minutely hairy, not winged, void of pinnæ below. Pinnæ opposite, from twelve to twenty pairs, the lower pair short, distant from the next, and often slightly drooping. Pinnules ovate, sharply serrated and pointed, the smaller confluent, the larger petioled and tapering at the base, particularly that on the upper side next the rachis. Sori light brown, one or two near the middle of each pinnule, at first linear, afterwards round, but very rarely or never covering the whole under surface.

The leaves of young plants are sometimes linear and simply pinnate.

This Fern has been repeatedly confounded with *Asplenium Adiantum nigrum*, though there is a very great dissimilarity between them; our present species is of a different shape, colour, size, and habit, its divisions less numerous, the naked part of its stem shorter, and its sori less extended; in fact, they vary in almost every particular.

SIT.—On rocks, &c., in the south of England, and in Wales.

HAB.—On the walls of the Church of St. Seneret, near the Land's End, Cornwall, *Jones's Tour*. Abundant around Penzance and St. Ives, *Mr. H. C. Walton*. Seilly Islands, *Mr. W. C. Trevelyan*. Sussex, *Mr. Borrer*. High rocks, near Tunbridge Wells (1835), *Mr. W. Pamplin*. Near Barmouth (plentiful), *Mr. J. E. Bowman* and *Mr. W. Wilson*.

GEO.—Azores, Bohemia, Hungary, France.

9.—ASPLENIUM ADIANTUM NIGRUM.

BLACK MAIDEN-HAIR. SHINING SPLEENWORT.

(Plate V, fig. 3.)

CHA.—Leaf triangular, tripinnate. Pinnæ elongate-triangular, alternate. Pinnules lanceolate, inciso-serrate, blunt. Leaf-stalk winged, black.

SYN.—*Asplenium Adiantum nigrum*, *Linn.*, *Willd.*, *Smith*, *Hook.*, *Mack.*, *Bolt.*, *Roth.*, *Huds.*, *With.*, *Galp.*, *Bernh.*, *Lightf.*—*Asplenium lucidum*, *Gray*, *Salisb.*—Black spleenwort, *Newm.*

FIG.—*E. B.* 1950.—*Flo. Dan.* 250.—*Bolt.* 17.—*Ger.* 1137.—*Newm. p.* 225 (1854).

DES.—Leaf tripinnate, ovate or triangular, 4 to 8 inches high, dark green, rigid, and erect. Leaf-stalk black, smooth, slightly winged, clothed with pinnæ only on the upper half. Pinnæ alternate, those only on the lower part twice pinnate, the lowermost the largest. Pinnules deeply cleft, tapering at their base, sharply serrated at and near the top. Sori linear at first, oblong at last, covering the whole under surface of the frond.

α. Leaves rigid, tripinnate only at the lower part. (*The common plant.*)

β. Leaves delicate, tripinnate throughout, alternate, segments linear, very acute. *Asplenium acutum*, *Newm. fig. p.* 231 (1854). *Asplenium Adiantum nigrum, var. Virgilii, Bory.*

Sir J. E. Smith, in conformity with the old authors, makes another variety, differing only from the common plant in having long fronds and distant pinnæ; but I leave any one to say if it be anything more than a drawn-up plant of the common species, found as it was, solitary, in a dark cave.

HAB.—*α*: Common through the United Kingdom, on walls, rocks, &c. I have habitats from the Orkney Islands, and from those in the English Channel, from the eastern as well as from the western counties, from Wales, Scotland, and Ireland. Dr. Murray writes me, "not common in the north of Scotland."—*β*: Limestone rocks at Mucruss, Killarney, *Mr. Mackay*, *Miss Hutchins.* and *Dr. Taylor*. Mount Cahir-Couree, six miles from Tralee, *Mr. W. Andrews.*

GEO.—Italy, France, Germany, Madeira, and high mountains of Carolina.

10.—ASPLENIUM FILIX-FÆMINA.

LADY FERN.

(Platc V, fig. 4.)

CHA.—Leaf lanceolate, bipinnate. Pinnæ tapering, pointed. Pinnules oblong, pinnatifid. Leaf-stalk scaly below, smooth above.

SYN.—*Asplenium Filix-fœmina*, *Hook.*, *Mack.*, *Spreng.*, *Bernh.*—*Aspidium Filix-fœmina*, *Swz.*, *Willd.*, *Smith*, *Hook. in Fl. Sco.*, *Galp.*—*Polypodium Filix-fœmina*, *Linn.*, *Lightf.*, *Huds.*, *Bolt.*, *Dicks.*, *With.*—*Polypod. ovato-crenatum*, *Hoffm.*—*Athyrium Fil.-fœm.*, *Roth.*, *Decan.*, *Presl*, *Newm.*, *Bab. Moore.*

FIG.—*E. B.* 1459.—*Flo. Dan.* 1346.—*Bolt.* 25.—*Pluk. Phyt.* 180, *f.* 4.—*Newm. p.* 63.

DES.—Rootstock large, tufted. Leaf-stalk with few scales above, green (rarely purple), the naked part very short. Leaf bipinnate, lanceolate, long-pointed, and tapering at the base, 12 to 20 inches high, dark green, very delicate in habit, often recurved. Pinnæ alternate, from twenty to forty pairs, oblong, tapering gradually to a point, the lower ones sometimes drooping. Pinnules very numerous, oblong, rather blunt, pinnatifid, or inciso-serrate, the serratures minutely toothed, but not aristate, the lower pair close to and parallel with the rachis. Sori solitary, near the base of the pinnules, at first linear-reniform, at length round, but not confluent. Indusium jagged, white, oblong or reniform.

[A very variable Fern, the forms of which some authors distribute into two species or more. The erect, narrowly lanceolate form, with linear pinnules, is *A. Rhætium*, *Roth.* (fig. *Moore*, 1853, p. 137). The broadly lanceolate, drooping form, with flat, oblong-lanceolate pinnules, is *A. Filix-fœmina*, *Roth.* (fig. *Moore*, 1853, p. 140).]

SIT.—Its natural habitation is swampy woods and damp hedgerows; or, as Sir Walter Scott incidentally remarks in his novel of ‘*Waverley*,’—

“Where the copse-wood is the greenest,
Where the fountain glistens sheenest,
Where the morning dew lies longest,
There the Lady Fern grows strongest.”

HAB.—Pretty freely distributed over the southern and midland counties of England and Ireland, though it is by no means abundant in North Wales or North Scotland, except in particular neighbourhoods.

GEO.—Throughout Europe; and from Canada to Virginia, in North America.

SCOLOPENDRIUM, Swz. HART'S TONGUE.

(Name from the sori diverging from the midrib, like the legs of a *scolopendra* or centipede.)



A, portion of a leaf of *Scolopendrium vulgare*, showing the origin of the fruit from lateral veins, and with its ordinary appearance. B, transverse section of the twin masses of fruit, with their folded indusia while in a young state. C, ripened fruit, in which the sori have become confluent, and thrown back the indusia. D, transverse section of the leaf-stalk. E, theca and spores. F, theca opened.

The sorus of this small genus appears to have two indusia, at first folded over each other, and afterwards thrown back in contrary directions; but in fact the sorus itself is no less double, two of them growing together so closely as to form in appearance but one mass; this is transverse, and seated between those lateral veins to which the two covers are attached.

SCOLOPENDRIUM VULGARE.

COMMON HART'S TONGUE.

(Plate V, fig. 5.)

CHA.—Leaf strap-shaped, acute, entire, cordate at the base. Leaf-stalk sealy.

SYN.—*Scolopendrium vulgare*, Smith, Hook., Spreng., Mack., Gray.—*Asplenium Scolopendrium*, Linn., Huds., Bolt., Woodv., Ehrh.—*Asplenium clongatum*, Salisb.—*Scolopendrium officinarum*, Swz., Willd., Pursh.—*Phyllitis Scolopendrium*, Newm. 1854.

FIG.—E. B. 1150.—Bolt. 11.—Flo. Lon. 67.—Ger. 1138.—Schk. Fil. 83.

DES.—Rootstock tufted. Leaves numerous, a foot high, strap-shaped, pointed, the base of them heart-shaped, smooth, except the lower part of the stalk and sometimes the midrib, which are very sealy. Sori attached to oblique transverse veins, always in twin united masses, each having its indusium attached, the one at the upper side, the other at the lower, these when young folding over each other in the middle. The twin sori are oblong, distant from other pairs, and chiefly at the upper part of the frond.

This plant is very apt to become differently cleft and crisped, remaining so under cultivation, and bearing fruit copiously in that state; hence the following varieties are noticed.

α (*vulgare*). Leaves ligulate, flat and single pointed.

β (*crispum*). Leaves crisped and curled along the margins.

γ (*multifidum*). Leaves much cleft at the top.

ε (*lineare*). Leaves very long and narrow.

The above, except β , can scarcely be considered distinct varieties, but should rather be accounted monstrosities, particularly γ , which is produced by over abundance of food and warmth; thus if the common state of the plant be transplanted to rich soil in a greenhouse, it will rarely ever fail to produce leaves cleft more or less towards the apex. These same plants, if again thrown out and neglected, will return to their original state. The spores of all the varieties will produce the common plant.

Sir J. E. Smith remarks, that "the whole plant has a nauseous scent when bruised, and is of a mucilaginous and acid taste." It is now discarded from the regular practice of medicine, but frequently still sold in our herb-shops, being used in an ointment for burns, &c., and taken internally as an astringent.

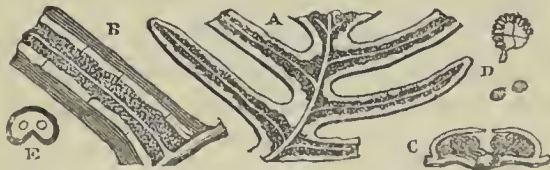
SIT.—In damp ruins, rocks, wells, &c.

HAB.—Scarcely a common Fern, though abundant in some places, particularly in the south and west of both England and Ireland, but decreasing in quantity northwards. Isle of Man, *Mr. E. Forbes*. Near Braunston, Leicestershire (rare), *Rev. A. Bloom*. In Wagg Lane, Congleton, Cheshire; also at Buxton, Matlock, and Dove Dale, Derbyshire, *Mr. H. C. Watson*. Near Leeds, *Mr. H. Denny*. Near Richmond and Settle, Yorkshire, *Mr. J. Tatham*. Three varieties on Pottery Carr, near Doneaster, *Mr. Appleby*. Hawkstone, Salop, *Mr. J. S. Bayly*. Abundant about Twickenham, Whitton, Hounslow, Brentford, &c., Middlesex; also at Barnes Common and Wimbledon Common, Surrey, *G. F. Arnison* Woods, Edinburgh, *Mr. W. Brand*. Cawdor Woods, *Mr. W. Stables*. Moray, *Rev. G. Gordon*. Sutherland, Aberdeenshire, and Kincardineshire, but by no means common, *Dr. Murray*. Orkney, *Dr. Gitties*. Near Wrexham, Denb., *Mr. J. E. Bowman*. Castell Aber, Lleiniog, Anglesea, *Mr. W. Leighton*. — γ : Caernarvon Castle, *Mr. J. F. M. Dovaston*. Carreg Onan, Anglesea, *Mr. W. Leighton*.

GEO.—Found throughout Europe, but sparingly towards the north. Very rare in North America, being, according to Pursh, found only in one place, viz., New York.

BLECHNUM, Linn. HARD FERN.

(From $\beta\lambda\eta\kappa\nu\nu$, a Greek name for a Fern.)



A, portion of a fertile leaf of *Blechnum boreale*. B, pinnule magnified, showing the covers or indusia. C, transverse section of sori, pinnule, and indusia. D, theca and spores. E, transverse section of leaf-stalk.

A genus of thirty-one species, known by bearing their fruit in closely united masses, not on transverse veins, as in *Scolopendrium*, but one on each side, and close to the midrib of the pinnule. Indusia attached on the outer side of each mass, opening on the inner side, but not folding over each other as in the last genus.

BLECHNUM BOREALE.

HARD FERN. ROUGH SPLEENWORT.

(Plate V, fig. 6.)

CHA.—Fertile leaves, strap-shaped, pinnatipartite, like a double comb, segments rather obtuse. Barren leaves pinnate, the pinnæ linear, acute.

SYN.—*Blechnum boreale*, Swz., Willd., Spreng., Smilh., Hook., Mack., Galp., Gray.—*Blechnum Spicant*, Roth., With.—*Osmunda Spicant*, Linn., Bolt., Hedw., Ehrh., Lightf.—*Osmunda borealis*, Salisb.—*Lonehitis aspera*, Ray, Ger.—*Acrostichum nemorale*, Lam., Fl. Fr.—*Acrostichum Spicant*, Sibth., Vill.—*Asplenium Spicant*, Bernh.—*Onoclea Spicant*, Hoffm.—*Lomaria Spicant*, Desv., Presl.—*Blechnum Spicant*, Newm. (1854).

FIG.—*E. B.* 1159—*Bolt.* 6.—*Flo. Dan.* 99.—*Ger.* 1140.—*Schk. Fil.* 110.

DES.—Rootstock black, tufted, sealy, with stout fibres. Leaf-stalk smooth and polished. Fertile leaves numerous, erect, strap-shaped, tapering at each end, about a foot high, pinnatipartite, partitions linear, dilated somewhat at the base, in some degree falcate, distant from each other, and alternate, wholly covered on the under side with fruit. Barren leaves broader and shorter than those which are fertile, and growing more on the outside of the plant, pinnate, their pinnæ oblong, curved upward, and placed close together at their bases, but scarcely dilated at that part. Sori continued in an uninterrupted line from the base to the point of each pinna, one on each side of the midrib. Indusium attached to very near the edge of the pinna, opening on the side nearest the midrib.

While young, the back of the pinna shows only the midrib and two irregularly edged white covers; afterwards these bend back and turn brown, and as in our species no leafy expansion appears outside the lines of the thecae, the indusium seeming to be the edge of the frond reversed, it might be taken at first sight for a *Pteris*, yet upon examination a narrow extension of the frond will be seen beyond the insertion of the indusia. A curious variety of *Blechnum boreale* is found by Miss Beever, near Ambleside. Its lobes are much distorted, serrated, toothed, or deeply crenate. I have ventured to name and figure a portion of one of the fronds kindly sent me by Miss Beever.

β (*stricta*). Frond linear, pinnæ abbreviated, and with irregular margins.



SIT.—On sandy heaths, hedgerows, stony places, &c.

HAB.—Spread throughout England, Scotland, and Ireland; in the last country especially in the counties of Wicklow and Clare. It ascends to 700 yards in Cumberland, 800 in Forfarshire, and much higher on the Cairngorun Mountains.

in Aberdeenshire, where it probably attains to situations of the height of 1200 or 1300 feet, *Mr. H. C. Watson*.

GEO.—Common in Germany, Denmark, Norway, Sweden, and north-west coast of America.

PTERIS, Linn. BRAKES.

(Πτερίς, a Fern; from πτερυξ, a feather.)



A, part of one of the divisions of the leaf. B, the same magnified, showing the continued indusium. C, transverse and perspective view of part of a pinnule. D, theca and spore. E, outer indusium magnified, showing its ciliated margin. F, transverse section of the leaf-stalk near the root. G, ditto of the creeping rhizoma.

A very extensive genus, comprising no less than 120 species, most of them from warm climates. One species only is British. The fructification is borne in a continued line along the margin of the frond, which appears to be turned over so as to form a continued indusium, but which upon microscopic examination is seen to be of different and more delicate structure; an inner indusium is also present in our and some other species, which many botanists consider a necessary character of a *Pteris*, and that its absence or presence might serve to divide the genus into two.

PTERIS AQUILINA.

BRAKES. BRACHEN. FEMALE FERN.

(Plate VI, fig. 1.)

CHA.—Leaf-stalks three-branched, branches bipinnate. Larger (upper) pinnules pinnatifid, smaller entire. Leaf-stalk smooth.

SYN.—*Pteris aquilina*, Linn. and all modern authors.—*Filix-fœmina*, Ray, Ger.
—*Asplenium aquilina*, Bernh.—*Pteris candata* β, Sehk.—*Eupteris aquilina*, Newm. 1854.

FIG.—E. B. 1679.—Ger. 1128.—Bolt. 10 (all bad).—Newman (1854), p. 23 (good).

DES.—Rootstock long and creeping, black and smooth when old, tomentose and brown when young. Leaf-stalk smooth, shining, without pinnæ on the lower part, tapering and black near its junction with the root. Leaves annual, erect, rigid, repeatedly divided, 2 to 5 feet high. Pinnæ opposite, more and more divided downwards, the smallest entire, the next pinnatifid, still lower ones pinnate, pinnato-pinnatifid, and twice pinnate. Pinnules opposite below, alternate above, oblong, blunt, connected to the midrib by their whole base, that terminating the pinna much larger than the others near it. Sori in a continued line around every sinuosity of

the pinna. Indusium adhering to the margin of the frond, within which is another cover, contrary or opposite to the outer one, and in like manner fringed. When the young leaves first uncoil themselves they are densely downy.

If the leaf-stalk be cut across near the root, it exhibits the bundles of vessels very plainly, in the form of an oak tree, or, as Linnæus thought, a spread eagle; hence its name *aquilina*. This is seen in the generic woodcut above, where also is a transverse section of the rhizoma, showing a totally different arrangement of vessels. The circumstance of the curious arrangement of vessels of the stalk was a matter of notoriety at a very early period. Thus we find in a most rare little book, entitled, 'A Dyalogue or Communiqueation of two persons devysed or set forth, in the Latin Tongue, by the noble and famous clarke Desiderius Erasmus, intituled, The Pilgrimage of pure Devotyon, newly translatyd into Englishe' (no date, supposed to be 1551), is the following curious passage:—"Peraventure they ymagyne the symylytude of a tode to be there; evyn as *we suppose when we cutte the fearne stalke there to be an egle.*"

This Fern is useful for many purposes, independently of the anthelmintic and astringent properties the herbalists attach to it. It is the favorite haunt of the deer tribe. As it is very long before it rots, and does not harbour insects, it is excellent as thatch; it does not hold moisture so much as straw, and is, therefore, better as litter for cattle, and as a cover to preserve plants from frost. It is also very excellent to lay fruit upon, or to pack it in, as it does not communicate any mustiness. Containing tannin, it is useful in the preparation of the lighter kinds of leather, and affords excellent potash when burnt. Its harsh texture and astringent taste render it unpalatable to cattle, though the roots are sought for by pigs, and have even been dried and ground for bread, but only in times of the greatest scarcity. Upon being boiled they yield a strong mucilage. The peasants of most parts of the kingdom assert their right to it as fuel, and use it chiefly to heat their ovens, a purpose for which it is well adapted, as it burns furiously. It is so valuable to the farmer of Germany for cattle fodder that it is an article of ready sale there, and the cutting of it subject to very severe forest laws.

It remains dormant during more than half the year, the fronds not appearing till the middle of May, and being cut off with the first slight frost of autumn. It is also very impatient under culture: to remove a root otherwise than with a considerable quantity of earth attached to it, or in any season but that of its torpidity, would assuredly destroy it, as would also cutting down the fronds three or four seasons in succession. The remarkable paucity of young fern plants, of almost every species, must have struck the attention of most botanists. A single frond of *Pteris aquilina* produces more seed than any number the mind can conceive; millions of leaves do often extend over a waste or park, yet how rarely is a young plant to be discovered anywhere. Indeed, had young plants been frequent, our ancestors could scarcely have imbibed the notion that they yielded no seed, or that it was a rarity, and only to be procured at the exact hour of the night on which John the Baptist was born. Pliny, says, "of fern be two kinds"

and they bear neither flower nor seed." Culpepper writing upon this Fern, which was in his time called Female Fern, "the seed of which," he observes, "some authors hold to be so rare," says, "such a thing there is, I know, and may be easily had upon Midsummer eve, and for aught I know, two or three days after it, if not more." The supposed circumstance of its seeding upon a single night, occasioned it to be called in Brown's 'Pastoral Ballads' (1613)—

"The wondrous, one-night-seeding ferne."

Butler alludes to this superstitious notion ('Hudibras,' Part III, cant. iii, 3, 4):

"That spring like fern, that insect weed,
Equivocally without seed."

Absurd as these notions are, they were not wholly exploded in the time of Addison. He laughs at a doctor "who was arrived at the knowledge of the green and red dragon, and had discovered the female fern seed." Then again, in the dawn of botany and medicine, when affinities and antipathies, or, as it was called, the doctrine of signatures, was supposed to rule all things, we find that this Fern must be good for reed wounds (punctured wounds), because, Dioscorides saith, "the fern dieth if the reed be planted about it; and, contrarywise, that the reed dieth if it be compassed with fern," which, as Gerard justly tells us, "is vaine to thinke that it hapneth by any antipathie or naturall hatred, and not by reason that this ferne prospereth not in moist places, nor the reed in dry." Another result of the admirable and scientific reasoning of Dioscorides was once prevalent in this country, that, because Fern seed was invisible, therefore, forsooth, those who carried it about them were rendered invisible also. This circumstance relative to Fern seed is alluded to in Beaumont and Fletcher's 'Fair Maid of the Inn':

"——— Had you Gyges' ring?
Or the herb that gives invisibility?"

Again, in Ben Jonson's play of the 'New Inn':

"——— I had
No medicine, Sir, to go invisible,
No Fern seed in my pocket."

Also, in Shakespere's 'Henry IV,' Part I, though here spoken ironically, Gadshill says—"We have the receipt for Fern seed, we walk invisible."

Several other country adages attach themselves to the Fern, as the following:

"When the Fern is as high as a spoon,
You may sleep an hour at noon;
When the Fern is as high as a table,
You may sleep as long as you're able."

Passing, however, these absurdities, of which many others might have been adduced, we may remark that very few of our poetical writers have thought the Fern tribe worth their attention. Miss Twanley, however, is an exception; she has many passages in the 'Romance of Nature,' and other works, which relate to them. She speaks of "the fan-like Ferns, which seem poised still and sleepily until the morn returns." In another place,—

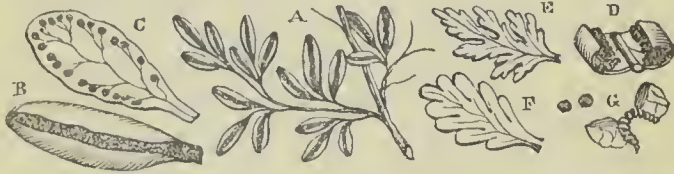
"The Ferns, too, are waving all stately here,
With seed-stored fronds thickly laid;
And shedding, when hastily brushed by the deer
Their light fertile dust o'er the glade."

SIT.—Upon barren heaths, in parks and woods, contenting itself occasionally with any soil or situation; it delights, however, in sand and strong loam, while it shuns the limestone and chalk districts: thus, if I recollect rightly, it is scarcely found on Salisbury Plain, nor do I remember meeting it anywhere in Kent except in sandy spots. Be it observed, however, that it is not wholly excluded from chalk and limestone, as I have seen it occasionally on both. It is not fond of a lofty situation, as, according to Mr. Watson, it is not found in places more than 500 or 600 yards above sea level.

GEO.—Generally distributed over Europe and in North America. The American species varies a little from ours, being rather more finely divided, somewhat ciliated, and earlier in growth.

CRYPTOGRAMMA, Br. ROCK-BRAKE.

(From *κρυπτος*, covered, *γραμμη*, a line; from the concealed lines of thecae.)



A, portion of a fertile leaf of *Cryptogramma crispa*. B, a pinnule somewhat enlarged. C, ditto with the lateral margins thrown back to show the position of the fruit. D, transverse section of the pinnule. E, pinnule of a barren leaf. F, a variety of ditto. G, theca thrown open, and spores.

Our only species was long considered a *Pteris*, because, although very different in habit, it has, like that genus, its fruit situated near the edge of the leaf in position of the fruit. D, however, the reflexed edge forming its cover. It differs, however, in having its sori not continued along all the undulations of the whole leaf, but confined to the sides of the separate pinnules.

CRYPTOGRAMMA CRISPA.

ROCK-BRAKE. STONE-FERN. CRISPED FERN. PARSLEY-FERN.

(Plate VI, fig. 2.)

CHA.—Leaf triangular, twice or thrice pinnate. Fertile pinnules oblong, blunt; barren ones wedge-shaped, cleft, crenate.

SYN.—*Cryptogramma crispa*, Hook., in *Br. Fl.*, Mack.—*Pteris crispa*, Linn., MSS., Wild., Swz., Hult, Wilk., Smith, Hook., in *Fl. Sco.*—*Osmunda rupestris*, Satisb.—*Osmunda crispa*, Linn. in *Sp. Pl.*, Huds., Lightf., Bott.—*Stegania onocleoides*, Gray.—*Onoclea crispa*, Roth., Hoffm.—*Allosorus crispus*, Bernh., Kaulf., Spreng., Bab., Newm.

FIG.—E. B. 1160.—Bolt. 7.—Flo. Dau. 496.—Pluk. *Phyt. t.* 5, f. 2.—Newm. 35 (1854).

DES.—Rootstock slightly creeping, long and fibrous. Leaf twice or thrice pinnate, deciduous, of a very lively green colour, 3 to 12 inches high. Leaf-stalk slender, smooth, and shining. Barren pinnules wedge-shaped or roundish, deeply cut and crenate; pinnæ nearly opposite, but not always so, four or five pairs.

Fertile fronds taller and more robust, but less expanded than the barren ones; their pinnæ more inclined to be alternate. Pinnules oblong, elliptic, blunt, their crenate sides turned over upon the sori, which are in lines along each side of the lobe, distinct only for a very short time at first, then very confluent and crowded.

SIT.—Southey calls this plant the “Mountain Parsley,” an appellation which well expresses its tender habit, its delicate, lively colour, and its numerous, finely cut, and crisped leaves. Covering large patches, as it sometimes does, on the tops of rocky mountains, it adds a bright gleam of verdure and of beauty to its romantic but barren dwelling-place, and becomes an oasis of rich fertility upon the precipitous face of the otherwise sterile rock.

HAB.—From 200 yards upwards to a considerable elevation in Caernarvonshire (top of Snowdon). In Cumberland from 200 or 300 yards to 1040 yards. In the Highlands, from the low valleys to 1100 yards on Ben-na Bourd. More common in the lake district of England than in Scotland, but frequent in several parts of the latter, *Mr. H. C. Watson*. Breiddon Hill (twelve miles west of Shrewsbury), *Mr. J. E. Bowman*. Greenfield, Saddleworth, *Mr. J. Merrick*. Higher parts of the Tees, *Mr. Hogg*. Common about Settle, Yorkshire, *Mr. J. Tatham*. Skiddaw, Helvellyn, Saddleback, Grassmoor, Vale of Newlands, &c., Cumberland, *Mr. H. C. Watson*. On rocks at the foot of Cheviot, above Langley Ford, *Mr. Finch*. Near Lancaster, *Mr. W. Wilson*.—WALES: Mount Glyder, Mount Snowdon, and Mynydd Mawr, Caernarvonshire, *Mr. C. C. Babington*. Cader Idris, *Mr. Purton*. North Wales (abundantly), *Mr. W. Christy*.—SCOT.: Ross-shire, *Rev. G. Gordon*. Glen Tilt and Blair Athol, Perthshire, *Mr. W. Brand*. Not rare in Sutherland, *Dr. Murray*.—IRE.: Abundant on the Mourne mountains, *Mr. Mackay*.

GEO.—Lapland, Germany, Switzerland, Pyrenees, Silesia, Sweden, Jutland, Norway, Dauphiny, Holland.

ADIANTUM, Linn. MAIDEN-HAIR.

(From α , without, and $\delta\iota\alpha\tau\alpha$, moisture; the plants never being wet.)



A, pinnules of *Adiantum Capillus-veneris*, showing the position of the sori and indusia. B, an indusium removed, showing the attachment of the sori, one indusium covering several. C, theca and ring. D, spore.

A very beautiful, delicate, and interesting genus of sixty-three species, indigenous to the southern countries of Europe and the tropical regions, this country being the northern limit of them all. The sori are arranged in spots along the margin of the pinnules, and covered by a reflexed membranous fold of the leaf.

ADIANTUM CAPILLUS-VENERIS.

TRUE MAIDEN-HAIR.

(Plate VI, fig. 3.)

CHA.—Leaf twice pinnate. Pinnules alternate, wedge-shaped, lobed, on capillary petioles. Indusium oblong.

SYN.—*Adiantum Capillus-veneris*, *Linn.*, *Wild.*, *Smith*, *Bolt.*, *Dicks.*, *Hook.*, *Mack.*—*Adiantum Capillus*, *Sez.*—*Adiantum fontanum*, *Salisb.*, *Gray.*—*Adiantum eoriandrifolium*, *Lam.*—*Capillus-veneris verus*, *Dill. in Ray's Syn.*, *Ger.*

FIG.—*E. B.* 1564.—*Bolt.* 29.—*Jacq. Misc. t. 7.*—*Ger.* 1143 (*bad*).—*Newm.* 1 and 8 (1854).

DES.—Rootstock slightly creeping and very hairy. Leaf-stalk slender, shining, rigid, purplish-black, without pinnæ on the lower part. Pinnæ alternate, in young leaves lobed only, afterwards pinnate. Pinnules wedge-shaped, crenate or cleft at the top, alternate. Sori marginal, in spots, one near the end of each lobe of the pinnule, the apex of which is turned over, forming a white, oblong cover, to which the fruit itself is attached.

The manner of the expansion of this plant is very singular and interesting. The young leaf is but slightly circinate in veneration, appearing at first with only one or two small wedge-shaped pinnules; after a time these split into lobes, which lobes become wider, long-stalked, and detached from each other, forming separate wedge-shaped pinnules, exactly similar to those from which they were detached; and if the plant be luxuriant, these again divide in a similar manner; thus some leaves are found pinnate, others twice, and sometimes thrice pinnate. The whole plant forms an interesting object for the microscope, particularly the membranous indusium, which is beautifully veined. The ring of the thecæ also is very different from that of any other British Fern. (*See cut of the genus.*)

VIR.—The properties of *Adiantum* are very uncertain. Its use is said to give name to the syrup *Capillaire*. It has neither fragrance nor flavour, and when boiled yields only a little mucilage.

HAB.—Port Kerig, Glamorganshire (verified 1834). Banks of the Carron, a rivulet in Kineardineshire, *Professor Beattie*. In a small cave on the east side of Carraich Gladden, a cove on the north coast of Cornwall, between Hayle and St. Ives, *Professor Henslow*. Isles of Arran, county of Galway, *Dr. Osborne*. At Wrisbeg, on a rock facing south-west on the shore of Loch Bulard, *Mr. C. C. Babington*. Dunraven, Glamorgans., *Prof. Hensley*. Ilfracome, Devon., *Dr. J. E. Gray*.

GEO.—South Europe, Isles of Bourbon, Teneriffe, Jamaica, and Hispaniola.

HYMENOPHYLLUM, Swz. FILMY FERN.

(Υμην, a membrane, φύλλον, a leaf; or the membranous-leafed Fern.)



A, part of a leaf of *Hymenophyllum Tunbridgense*. B, the same slightly increased to show the veins of the leaf, and the origin and character of the fruit. C, sorus magnified, and one of its covers removed. D, theca, with transverse ring. E, the same opened. F, spores.

In this small and delicate genus, a lobe of the pinna is constructed into the fruit and its receptacle, the lamina of the lobe forming two valves, inclosing

between them the midrib, to near the end of which are attached several ringed and petioled thecæ, the annulus of which does not coincide with the petiole, but is placed transversely. (See Introduction.)

1.—HYMENOPHYLLUM TUNBRIDGENSE.

TUNBRIDGE FILMY FERN.

(Plate VI, fig. 4.)

CHA.—Leaf pinnate. Pinnæ pinnatifid, erect. Lobes serrate. Leaf-stalk winged. Involucre orbicular, serrate at the top.

SYN.—Hymenophyllum Tunbridgense, *Smith, Willd., Hook., Mack., Swz., Gray.*—Trichomanes Tunbridgense, *Linu., Huds., With., Bolt., Lightf.*—Trichomanes pulchellum, *Satsb.*

FIG.—*E. B.* 162.—*Hook. in Flo. Lon.* 71.—*Bolt.* 31.—*Flo. Dan.* 954.—*Hedw.* 3.—*Forst. in Flo. Tonb. (excellent).*—*Newm. p.* 297 (1854).

DES.—Root-stock black, fibrous, hairy, extensively creeping, rather upon than under the surface of the ground. Leaf-stalk naked on the lower part, capillary, black, broadly winged all the way down. Leaves solitary, at intervals along the creeping stem or root-stock, 1 to 2 inches high, of a light green colour. Pinnæ alternate, growing quite upright, their veins dichotomously branched. Lobes sharply serrated or toothed, linear and blunt-pointed, running into each other, and seated chiefly on the upper side of what may be called the midrib of the pinna, but not wholly confined to that side, as in the next species. Receptacles formed from and in the place of the last lobe, on the upper side of each pinna; thus they appear in two rows, one on each side of the rachis. The receptacle is composed of two flat or slightly convex, roundish valves, folding over each other, and sharply serrated at the points; between which is a free column covered with thecæ.

SIT.—On damp, shady rocks, generally among moss.

HAB.—On the moist and shady sides and fissures of the various rocks near Tunbridge Wells, viz., the High Rocks, and the rocks in Eridge Park (abundant, 1835), *Mr. W. Pamplin.* Clefts of the rocks at Wistman's Wood, Dartmoor; rocks by Dunsford Bridge, Beekley Fall, &c., Devon, *Flo. Dev.* Greenfield, near Saddleworth (very rare), *Mr. W. Wilson.* Near Halifax, *Mr. Leyland.* Near Cader Idris and Dolgelly, *Mr. Bowman.* Very abundant and fine near the Upper Lake, Killarney, *Mr. W. Wilson.* Powerscourt Waterfall, Glenree, and other places in the county of Wicklow, *Mr. Mackay.*

GEO.—This, and probably the next species, are scattered over Europe from Italy to Norway.

2.—HYMENOPHYLLUM WILSONI.

NORTHERN FILMY FERN. WILSON'S FILMY FERN.

(Plate VI, fig. 5.)

CHA.—Leaf pinnate. Pinnæ semi-pinnatifid, recurved. Lobes serrate. Leaf-stalk scarcely winged. Receptacle ovate, entire.

SYN.—*Hymenophyllum Wilsoni*, *Hook. in Br. Flo., Mack.*—*Hymenophyllum unilaterale*, *Newm.*

FIG.—*E. B. Suppl.* 2686.—*Newm. p.* 301 (1854).

DES.—Leaf-stalk rigid, capillary, winged at the top. Leaf 1 or 2 inches high, dark green. Pinnæ alternate, bent backwards, growing horizontally rather than vertically as in the last species, besides which the lobes curve downwards, so that when the edge of them is looked at they have a falcate appearance, although they are oblong and blunt, and it may be added, very sharply serrated. When in fruit, all the leafy expansions turn in one direction, and the fruit in the opposite. The receptacles are situated as in the last species, but are larger, very convex, perfectly ovate, and entire.

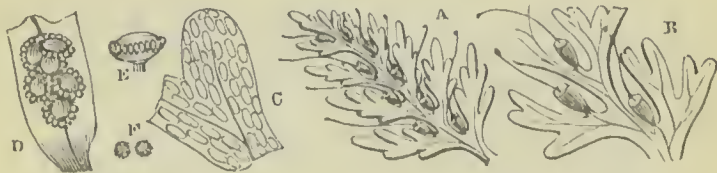
The narrow wing of the leaf-stalk, the different habit, the semi-pinnatifid character of the pinnæ, and the entire, convex receptacles, serve to distinguish this from *Hymenophyllum Tunbridgensis*, with which it was confounded, until shown to be distinct by that accurate botanist, Mr. W. Wilson.—Miss Beever has sent me fronds from Coniston, which are much branched.

SIT.—On moist alpine rocks, near waterfalls, &c.

HAB.—Waterfall above Ambleside, Westmoreland, *Mr. J. Bowerbank*. Black Rocks of Great End, in the Seawfell range, and at Seale Foree, near Buttermere, Cumberland (1833), *Mr. H. C. Watson*. Greenfield, near Saddleworth, and near Silverdale, Lancashire, *Miss Beever*.—WALES: On Snowdon, near Llanberris Pass, and on the adjacent mountains, especially near Tŷll Du, *Mr. W. Wilson*. Rocks about Nant Phranean, in situations from 200 to 650 yards of elevation, *Mr. H. C. Watson*. On rocks near the Rhydol, Montgomeryshire, at a plank over a dangerous gulf of the river Pont Bren, *Mr. E. Lees*.—SCOT.: Finlarig Burn, near Killin, Perthshire, *Mr. Wilson*. Argyleshire, *Mr. J. Hooker*.—IRE.: At Killarney (very plentiful), *Mr. Wilson*. Shannafolia Mountain, *Mr. C. C. Babington*. Kerry mountains, Connauara, &c., *Mr. Mackay*.

TRICHOMANES, Linn. BRISTLE-FERN.

(Οριζ, τριχος, a hair, and μαρος, loose or long; from the free hairs which terminate the receptacles.)



A, pinnule of *Trichomanes brevisetum*. B, portion of ditto, with fruit enlarged. C, ditto, still more enlarged, to show the loose cellular structure of the leaf. D, longitudinal section of the sorus magnified. E, theca, with transverse ring. F, spores.

All the species of this beautiful genus, amounting to forty-six in number, are very cellular and tender, their fruit attached to the midrib of a lobe, as in the last genus, but here the receptacle is one-ribbed, and the midrib not terminated by the thecae, and confined within the receptacle, but projecting much beyond it, and like a hair in appearance. We have but one species, and that very rare.

TRICHOMANES BREVISETUM.

SHORT-STYLED BRISTLE-FERN. CUP GOLDDLOCKS.

(Plate VI, fig. 6.)

CHA.—Leaf triangular, thrice or four times pinnatifid. Lobes linear, entire or bifid, obtuse. Leaf-stalk winged. Receptacles elongate cup-shaped.

SYN.—*Trichomanes brevisetum*, *Hort. Kew.*, *Hook. in B. Fl.*, *Smith in E. Fl.*, *Mack.*—*Trichomanes alatum*, *Hook. in Flo. Lon. N. S.*, *Swz.* (not of *Wittl.*)—*Trichomanes pyxidiferum*, *Huds.*, *Bolt.*, *With.*, *Hutt.*—*Hymenophyllum alatum*, *Smith in E. B.*, *Wittl.*—*Hymenophyllum Tunbridgens* β , *Smith in Fl. Br.*—*Trichomanes radicans*, *Hook. and Arnott*, *Bab.*, *Moore*, *Newm.*

FIG.—*E. B.* 1417.—*Ray*, *Syn. t.* 3, *f.* 3.—*Bolt.* 30.—*Flo. Lon.* 53.—*Newm. p.* 283 (1854).

DES.—Rootstock very thick, black, and densely hairy. Leaf-stalk smooth and winged all the way down. Leaf pellucid, membranous, dichotomously branched in all its parts, 6 to 12 inches high, dark green. Pinnæ alternate, twelve or fourteen pairs, vertical, much cleft, lobes ultimately linear, but everywhere running much into each other, their veins conspicuous, prominent, and beautifully branched. Receptacles pitcher-shaped, taking the place of lobes, but not confined to those nearest the main stem, as in the last genus.

β (*Andrewsii*). Leaf lanceolate, receptacles winged.

HAB.—Near Killarney, in several situations, *Mr. W. Wilson*. Hermitage, in the county of Wicklow, *Mr. Nuttall*. Powerscourt Waterfall, *Mr. Mackay*. Once found in Ballinhasy Glen, near Cork, by *Mr. J. Drummond*. Glendine, near Youghal, county of Cork, is another habitat for this plant, as discovered by *Mr. Balt*, of Dublin. It grows here in great luxuriance.

GEO.—St. Domingo, Jamaica, the Caribbees, Madeira, &c.

OSMUNDA, Linn. ROYAL FERN.

(*Osmund*, *Sax.*, strength; this being the largest and strongest of our Ferns.)



A, portion of a leaf of *Osmunda regalis*, natural size. B, mass of fruit magnified. C, theca separated. D, ditto splitting open. E, transverse section of the leaf-stalk. F, spores. G, epidermis of a pinnule. H, epidermis of the stalk.

In this genus the upper part of the leaf becomes changed into a compound spike of fructification, without any indusium or receptacle. *Osmunda* is a small genus, the species of which very much resemble each other in size and character. They are natives of Europe and North America.

OSMUNDA REGALIS.

ROYAL FERN. WATER-FERN. FLOWERING FERN.

(Plate VII, fig. 1.)

CHA.—Leaf bipinnate. Pinnules oblong, nearly entire, slightly auricled. Sori terminal.

SYN.—*Osmunda regalis*, Linn., Willd., Bolt., and all modern botanists.

FIG.—*E. B.* 209.—*Bolt.* 5.—*Flo. Dan.* 217.—*Flo. Lon.* 150.—*Ger.* 1131.—*Newm.* p. 310 (1854).

DES.—Rootstock a thick, short, scaly, and fibrous tuber. Leaf-stalk smooth, rigid, upright. Leaves several, 2 to 6 feet high, bright green, twice pinnate. Pinnæ distant, nearly opposite. Pinnules almost sessile, oblong, blunt, with waved or slightly crenate edges, frequently auricled. Those pinnæ on the top of the leaf are either wholly or partially changed into fructification, when they appear like a compound spike, each bunch of which seems composed of a number of circular bundles of capsules. The thecæ are stalked and beautifully reticulated. Spores nearly globular.

VIR.—The internal parts of the root, as well as the young leaves, were once used in pharmacy as a cure for bruises, and as conferring strength.

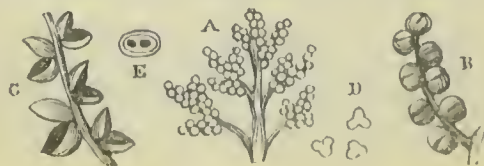
SIT.—In wet woods, swampy moors, &c. (See *Introduction*, page 11.)

HAB.—SCOT.: Head of Loch Fine, to the N. E. of Inverary, Argyleshire, and near Loch Lomond (Dumbarton side), *Mr. H. C. Watson*. At the side of the loch at Inchnedamff, Sutherlandshire, *Dr. Johnston*. Aberdeenshire and coast of Kincardineshire, *Dr. Murray*.—ENG.: Warwickshire, *Rev. W. Bree*. Ellesmere Lakes and West Felton, Salop, *Mr. W. Leighton*. Plentiful at Speke, near Liverpool, *Mr. T. B. Hall*. Chat Moss, *Mr. W. Christy*. Woolston Moss and other places near Warrington, Lancashire, *Mr. W. Wilson*. Isle of Man, *Mr. Forbes*. Pottery Car, near Doneaster, *Mr. S. Appleby*. Near Leeds, *Mr. Denny*. Bulwell, Notts (near the upper mill), *Mr. T. H. Cooper*. Norfolk, *Miss Bell*. Kavanah's Wood, Great Warley Common; also near the barracks, on Little Warley Common, *Mr. R. Castle*. Near Leith Hill, Surrey; and in several places from 5 to 8 miles S. W. of Dorking, *Mr. W. Pamplin*. On Bagshot Heath, *Mr. J. Lloyd*. In a wet shady spot, by the river side, between Frimley village and Frimley Green, Surrey; also sparingly on Esher Common, by the entrance to the lane leading thence towards Epsom, *Mr. H. C. Watson*. Tunbridge, *Mr. Trevelyan*. Corner of the lake at Uckfield, Sussex; near Chindleigh, on the banks of the Teign; also near Ivybridge on the Erme; and on the Goonhilly Downs, about St. Ives, *Jones's Tour*. Isle of Wight, *Rev. G. E. Smith*.—IRE.: Mueruss Abbey, *Mr. Kelly*. Castlebar, Mayo, *Dr. Osborne*. Kelly's Glen, co. Dublin, &c., *Mr. Mackay*.

Geo.—Europe, chiefly the northern parts, and all the United States.

BOTRYCHIUM, Linn. MOONWORT.

(From *βοτρυς*, a bunch; as its fruit is borne in clusters.)



A, fertile branched spike of fruit of *Botrychium Lunaria*. B, part of ditto enlarged. C, ditto with the thecæ opened. D, spores. E, transverse section of the leaf-stalk.

The fruit in this somewhat extensive genus is produced upon a compound spike formed from one of the two principal branches into which the leaf-stalk divides. The thecæ are opaque and sessile. Only one British species has been recorded until lately, but there are two forms regarded as distinct on the continent. (See Introduction.)

BOTRYCHIUM LUNARIA.

COMMON MOONWORT.

(Plate VII, fig. 2.)

CHA.—Fertile division of the leaf pinnate, solitary. Pinnæ fan-shaped, crenate.

SYN.—*Botrychium Lunaria*, Swz., Willd., Hook., Mack., Smith in *E. Fl.*, Gray. —*Osmunda Lunaria*, Linn., Smith in *Fl. Br. and E. B.*, Bolt., Lam., Dicks., Ehrh.—*Osmunda lunata*, Salisb.—*Lunaria minor*, Ger., Ray, Matth., Camer., Fuchs., Gesner, &c.

FIG.—E. B. 318.—Bolt. 4.—*Flo. Dan.* 18, f. 1.—*Flo. Lon.* 66.—*Newm.* p. 100.

DES.—Rootstock a kind of slender tap-root, giving off thick, smooth, yellow radical fibres. Leaf of a dull yellowish-green, 2 to 6 inches high, rarely more than one from a root, quite smooth in every part. Leaf-stalk hollow, rather succulent, half way up it divides into two branches, one being a pinnatifid or pinnate leaf, the other the fruit-spike. Pinnules of the leafy part five or six pairs, opposite, decurrent, fan-shaped, regularly crenate. Fruit covering the upper part of the other branch of the stalk in a compound spike, not in aggregate clusters, as in *Osmunda*, but separate, though nearly touching each other, and arranged in single lines along the branches of the spike. The thecæ are opaque, sessile, round, smooth, yellow at first, afterwards brown. Spores oval, smooth, generally attached to each other in pairs.

VIR.—Its virtues are more imaginary than real, more magical than physical. Its name *Lunaria*, or Moonwort, is taken from the shape of the leaves, and gathered by the light of the moon, was said to “doo wonders.” Gerard mentions a remarkable instance of the properties attributed to it by the alchemists and witches, “that it will loose locks, and make them fall from the feet of horses that do graze where it doth grow;” “too drowsie a dream” for even the credulous Gerard to believe; but he adds, that it is “singular for wounds.”

[*B. Lunaria* δ , Smith (*Botrychium rutaceum*, Swz.), has the barren division of the leaf pinnatifid, with the partitions *pinnatifid*. When the pinnæ of *B. Lunaria* are divided it is usually upon the *fan-shaped* plan of the venation. It has been found in Westmoreland and near Dundee, and probably has been overlooked. (Fig. *Newm.* 1854, p. 322.)]

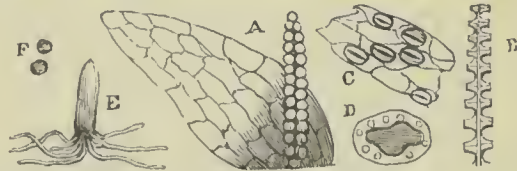
SIT.—In pastures chiefly in the northern and mountainous countries.

HAB.—SCOT.: Bernerside Hill, W. of Berwickshire, *Mr. W. Baird*. South side of Loch Tay, and ascending to 3000 feet on adjacent mountains; Clova and Pentland Hills, &c., *Mr. H. C. Watson*. Blair Athol, Perthshire, *Mr. W. Brand*. Moray, *Rev. G. Gordon*. Orkney, *Rev C. Clouston*. Aberdeenshire, *Dr. Murray*. —ENG.: Sea-banks near Tynemouth, Northumberland, *Miss Hancock*. Higher Tees, *Mr. J. Hogg*. Newcastle Town Moor, *Mr. R. Bowman*. Common about Settle, Yorkshire, *Mr. J. Tatham*. Warwickshire, *Rev. W. Bree*. Southport, Lancashire, *Mr. Rylands*. Greenfield, near Manchester, *Mr. J. Merriek*. Cheshire and Derbyshire, *Mr. W. Wilson*. Pottery Car, *Mr. S. Appleby*. Clifton, Norton, Fiskerton, Newstead, and Sherwood Forest, Notts, *Mr. T. H. Cooper*. Shotover Hill, Oxon., *Mr. Baxter*. Linton, Cambridgeshire, *Mr. C. C. Babington*. Near Titchborne, Hants (1836), *Mr. Forder*. Leith Hill, Surrey; Shirley Common, near Croydon, Surrey; between Dartford and Footseray, Kent; and S. W. of Petersfield, Hants, *Mr. W. Pamplin*. Deepdene, near Dorking, *Mr. J. Nash*. South Kent, *Rev. G. E. Smith*. Near Barnstaple, Devon (1836).—WALES: Near Wrexham, *Mr. J. E. Bowman*. Near Rodney's Pillar, Montgomeryshire, *Rev. A. Bloxam*. Craig Breidden, *Mr. Dovaston*.

GEO.—Throughout North Europe and North Asia.

OPHIOGLOSSUM, Linn. ADDER'S TONGUE.

(From *οφις*, a serpent, and *γλωσσα*, a tongue.)



A, fertile and barren lobes of the leaf of *Ophioglossum vulgatum*. B, fertile lobe after it has shed its spores. C, epidermis. D, transverse section of the leaf-stalk. E, rootstock and veneration. F, spores.

This genus bears its fruit in a simple spike forming one lobe of a two-parted leaf. The thecae are connected not only to each other, but attached by their whole base to the rachis which bears them; when ripe they open transversely. There are about twelve foreign species of this genus, inhabitants of Europe and North America.

OPHIOGLOSSUM VULGATUM.

COMMON ADDER'S TONGUE.

(Plate VII, fig. 3.)

CHA.—Barren lobe of the leaf entire, usually solitary, ovate, obtuse.

SYN.—*Ophioglossum vulgatum* of most botanists.—*Ophiog. ovatum*, *Salisb.*

FIG.—*E. B.* 108.—*Bott.* 3.—*Flo. Lon.* 78.—*Flo. Dan.* 117.—*Ger.* 404.—*Sehk* 153.—*Newm. p.* 325 (1854).

DES.—Rootstock small, spindle-shaped or ovate, with many stout, yellow, smooth radical fibres, running horizontally. Barren lobe of the leaf entire, upright, ovate, blunt, 2 to 6 inches high, of a lurid green colour. Stalk tapering downwards, and hollow. Fertile lobe a single, unbranched, stalked, and pointed spike, connected with the leafy expansion. Thecae yellow, opaque, sessile, in two single rows, connected with each other, so that after the round, smooth, yellow

spores are dispersed, a number of transverse elefts are seen along each side of the spike. Sometimes found with more than one spike, at other times the leaf-like lobe is deeply eleft at the top.

[*O. lusitanicum*, *L.*, which is probably only a variety, has been found in Guernsey. It is distinguished by its lanecolate or linear barren lobe, and by its minute dimensions (1—2½ inches high).]

VIR.—It is considered by the country people as valuable to form an ointment for wounds, and for this purpose is gathered by basketfuls; for be it observed that in some parts of the country it is almost as abundant as the herbage among which it grows.

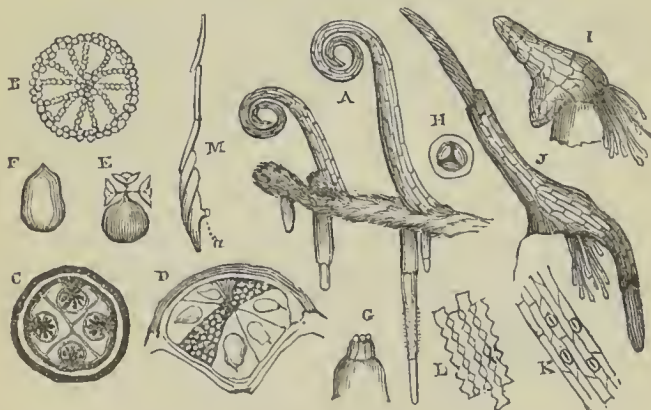
SIT.—In meadows and moist pastures in most parts of the kingdom. (See *Introduction*.)

HAB.—**Scot.:** Dalmeny Woods, near Edinburgh, *Mr. W. Brand*. Orkney, *Rev. C. Clouston*. Balmuto, *Miss Boswett*. Carlowrie, *Mr. Falconer*.—**Eng.:** Middleton-one-row, Durham, *Mr. R. Bowman*. Round Howe, near Richmond, Yorkshire, *Mr. J. Ward*. West Felton, Salop, *Mr. W. Leighton*. Warwickshire, *Rev. W. Bree*. Field behind Heawood Hall, Alderley Cheshire, *Mr. H. Watson*. Near Warrington, Lancashire, *Mr. W. Witson*. Near Braunston, Leicestershire, *Rev. A. Bloxam*. Heanor, Derbyshire, and Colwiek, Notts, *Dr. Howitt*. Pottery Car, *Mr. S. Appteby*. Near Bristol, *Miss Worstey*. Somerset, *Mr. A. Southby*. Norfolk, *Miss Bell*. At the side of the pond, in Wike Farm, Sion Lane, Isleworth; near the ladder stile, Osterley Park, near Brentford, Middlesex; and four miles south of Dorking (abundant), *Mr. J. Bevis*. Various parts of Surrey, Kent, Herts, and Hants, *Mr. W. Pamplin*. Meadows of Long Leet, Wiltshire, *Mr. Rowden*. Sussex, *Mr. H. C. Watson*. Near Slateford, near Barnstaple, Devon, *Mr. J. Nash*.—**Wales:** Near Wrexham, *Mr. J. E. Bowman*.—**Ire.:** Lawn of the Observatory, Dunsink, *Mr. Kelty*. Not unfrequent in Ireland, *Mr. Mackay*.

GEO.—Throughout Europe, and from New York to Pennsylvania in North America.

PILULARIA. PILLWORT.

(From *pitula*, a pill; from the shape of its seed-vessels.)



A, shoot of *Pilularia globutifera* magnified, showing the vernal shoot, rhizoma, and roots in different states. B, cross section of the root. C, of the capsule, D, one quarter of ditto, still further magnified, showing the spores and theca. E, fertile spore. F, point of ditto in germination. H, front view of the end of ditto

in germination (*arehegonium*). I and J, germination still further advanced. K, epidermis of the stem. L, membrane which divides the root into various cells. M, hair from a capsule; a, its point of attachment. The germination taking place from a determinate point, shows that the word spore is, as relative to the *Pilularia*, a misnomer, and that the reproductive grains are analogous to real seeds. These figures are taken from Mr. Valentine's paper mentioned in the Introduction.

PILULARIA GLOBULIFERA.

CREEPING PILLWORT. PEPPER-GRASS.

. (Plate IV, fig. 10.)

CHA.—Leaves filiform. Stem creeping. Capsules coriaceous, hairy, nearly radical.

SYN.—*Pilularia globulifera* of all botanists.

FIG.—*E. B.* 521.—*Bott.* 40.—*Flo. Dan.* 223.—*Hook. in Flo. Lon.* 83.

DES.—Stem very long, cylindrical, and creeping close to the ground, throwing off at intervals of half an inch or more several simple, very small, smooth, radical fibres, and from the same part upwards from two to six filiform, hollow, green leaves, about 2 inches long, among which, at their base, grow one or two capsules, not radical, as generally said, but attached to the *upper* part of the stem, and therefore, although near the roots, not attached to them. The capsules are round like a peppercorn (hence the name of the plant), brown, and hairy. The large spores contained singly in the thecae, are oblong, contracted in the middle, and slightly pointed at one end. The small spores are contained in large numbers in the thecae.

SIT.—Pools of water, edges of lakes, &c., not uncommon.

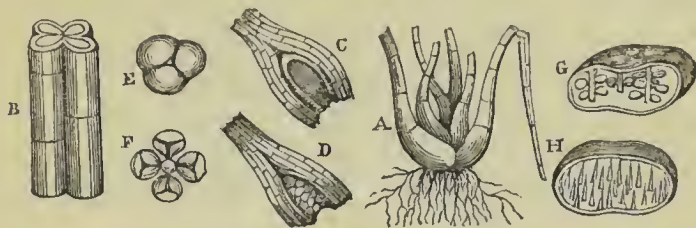
HAB.—SCOT.: Near Inverskin, Sutherland, *Mr. Campbell*. Marshy ground between the village of Currie and the Pentland Hills, Edinburgh, *Mr. H. Watson*. Near Slateford, Forfarshire, *Mr. W. Brand*.—ENG.: Prestwich, near Northumberland, *Mr. R. Bowman*. Coleshill Pool, Warwickshire, *Rev. W. Bree*. Bomere Pool, Salop, *Rev. E. Williams*. Near Richmond, Yorkshire, *Mr. J. Ward*. Beam Heath, near Nantwich, Cheshire, *Mr. J. E. Bowman*. Once plentiful at Barnington Heath, Cheshire, and still found at Baguley Moor, in the same county, *Mr. W. Wilson*. Filby and Hopton Commons, near Yarmouth, *Mr. Paget*. Once and perhaps still in the ponds at Rochampton, Surrey; and on Iver Heath, Middlesex, *G. F.* In a small pool between Oakshot Hill and Claremont Park, Surrey, *Mr. H. C. Watson*. Sussex, *Rev. G. E. Smith*. Grosvenor and Roche, Cornwall, *Jones's Bot. Tour*.—WALES: Near Llanfawcloy, Anglesea; and border of Llyn Idwel, Caernarvonshire, *Mr. W. Wilson*.

GEO.—Most parts of Europe.

ISOETES, Linn. QUILLWORT.

(From *ισος*, equal, and *ετος*, the year; the plant being evergreen.)

PLATE OF GENERA, FIG. XVIII.



A, lower part of a plant of *Isoetes lacustris*, half the natural size. B, portion of the filiform leaf, magnified. C, receptacle of the larger kind of spore. D, receptacle of the smaller spores. E, large spore magnified. F, group of four small spores. G and H, sections of the receptacles.

ISOETES LACUSTRIS.

EUROPEAN QUILLWORT. MERLIN'S GRASS.

CHA.—Leaves awl-shaped, bluntly quadrangular, formed of four transversely-jointed longitudinal tubes.

SYN.—*Isoetes lacustris* of all modern botanists.

FIG.—E. B. 1084.—Flo. Lon. N. S. 131.—Bolt. 41.—Flo. Dan. 191.—Schk. fl. 173.

DES.—Root-stock a kind of corm bearing, long, branched, smooth radical fibres. Leaves radical, tufted, filiform or awl-shaped, 2 to 4 inches high, light green, and very brittle. Receptacles immersed in the base of the leaves: the outer, which are also the larger and older leaves, bearing large spores, the inner and younger leaves producing small spores, as explained in the *Introduction*.

Mr. W. Wilson finds two varieties in Wales; the one densely tufted, with slender erect leaves, the other with broader and widely-spreading leaves. The former of these, Dr. Hooker thinks, may be the *Isoetes setacea* of Bosc. Sprengel says, "that the plant grows at the bottom of carp-ponds, where it would not be of very easy access, did not the fish assist the botanist by disengaging it from the mud, when it is found floating at the edges of the pond."

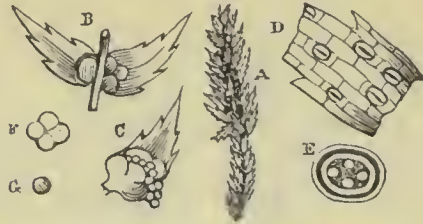
SIT.—Found only in the extreme north of Wales, north of England, and in Scotland, which is a curious circumstance, because submerged water plants are not in general so strictly confined to particular latitudes or altitudes.

HAB.—SCOT.: Loch Callader, Aberdeenshire, and Loch Brandy, Forfarshire, Mr. W. Brand. Loch Whirral, Forfarshire, Dr. Graham. Loch Tay, Perthshire, Dr. Greville. Most of the Scottish Lakes, Mr. H. C. Watson.—IRE.: Lakes in the Rosses, Donegal, Rev. Mr. Murphy.—ENG. and WALES: Prestwich Carr, Northumberland, B. G. Ulleswater, Cumberland, Mr. Williams. Coniston Lake, Miss Beever. In Llyn-y-cwm, Plynnon Friei (Snowdon), Lake Owgan and Llanberris lakes; also in Floutern Tarn, between Scale Force and Whitehaven, Mr. W. Wilson. Lakes of Denbighshire, Mr. J. E. Bowman.

Geo.—More copious in Sweden and Denmark than elsewhere. New York and northwards in America.

LYCOPODIUM, Linn. CLUB-MOSS.

(From *λυκος*, a wolf, and *πους, ποδος*, a foot; the ends of the stems appearing like the hairy feet of some animals.)



A, spike of fruit of *Lycopodium selagiuoides*, natural size. B, two leaves or bracts of ditto; one showing the receptacle for larger spores; the other the receptacle for the smaller. C, receptacle opening and scattering the smaller spores. D, epidermis of a leaf. E, section of the stem. F, receptacle or sporangium of large spores. G, spore.

A very extensive genus of no less than 140 species, found in all parts of the world, some in the hotter, and others in the colder countries. Six only are natives of Britain, and these are far inferior in beauty of appearance to many of foreign growth. The *Lycopodia* were always taken for and called Mosses by the old botanists; and they do indeed resemble that tribe in many of their external characters, having sessile, smooth, entire, or at most serrated leaves. Their fruit, however, is greatly different; many species of the *Lycopodia* bear it in terminal scaly spikes, in others, among which is our *Lycopodium Setago*, the fruit is not confined to the apex of the branches, but is found in the axils of the leaves throughout the whole plant. The roots grow from every part of the stem which touches the ground.

LYCOPODIUM CLAVATUM.

COMMON CLUB-MOSS. FOXTAIL. STAG'S HORN. WOLF'S CLAW.

(Plate VI, fig. 1.)

CHA.—Stem trailing. Leaves linear, incurved, hair-pointed. Thecae in naked, stalked, double spikes. Scales ovate, serrate.

SYN.—*Lycopodium clavatum* of most botanists.—*Muscus clavatus* seu *Lycopodium*, Ger., Park., &c.—*Lycopodium officinale*, Neek.—*Lepidotis clavata*, Beauv.

FIG.—E. B. 224.—Ger. 1562.—*Phytologist*, No. 1, p. 1.

DES.—Roots fibrous, at the forks of the stem. Stem branched, several feet long, lying on the ground, bright green. Leaves crowded, linear, curved, with a long, diaphanous, hair-like point. Spikes of fruit cylindrical, usually in pairs, yellow, about an inch long, supported upon a rigid, upright long stem, which is void of leaves, but set at intervals with whorls of very fine, short setae. Scales of the spikes broadly ovate, pointed, and dentate or serrate. Thecae large, round, one to three, attached to the base of each scale, and filled with a very fine yellow powder (spores).

VIR.—For the virtues of this plant, see page 19; in addition to which it is said to be used to ameliorate wines, but its emetic properties render this doubtful.

SIT. and HAB.—On hill-sides, particularly in the northern part of the kingdom, but not ascending to so lofty a situation as some other species. Hoy Hill, Orkney, *Rev. C. Clouston*. Plentiful in the Highlands, in Cumberland, and in North Wales, *Mr. H. C. Watson*. Charnwood Forest, Leicestershire, *Rev. A. Bloxam*. Todmorden, Lancashire, *Mr. W. Wilson*. Settle, Yorkshire, *Mr. J. Tatham*. Derbyshire, *Dr. Howitt*. Coleshill, Warwickshire, *Rev. W. Bree*. Notts, *Mr. T. H. Cooper*. Oxfordshire, *Mr. Baxter*. Somerset, *Mr. A. Southby*. Woking Heath, Surrey, between the Canal and Railway, 200 or 300 yards S.-W. of the Station-house, *Mr. H. C. Watson*. Lane between Dorking and Leith Hill, and on Addington Hills, beyond Croydon, Surrey; also on the high heathy ground above Tring, Herts, *Mr. W. Pamplin*. Sussex, *Rev. G. E. Smith*.—IRE.; Kelly's Glen, Ballynascorney, and other places on the Dublin Mountains, *Mr. Mackay*.

GEO.—In most of the northern parts of Europe and Asia, and from Canada to Pennsylvania in America.

2.—LYCOPIDIUM ANNOTINUM.

INTERRUPTED CLUB-MOSS.

(Plate V, fig. 2.)

CHA.—Stem procumbent. Leaves in five rows, lanceolate, acute, spreading. Spikes simple, scales broadly ovate, imbricated.

SYN.—*Lycopodium annotinum*, *Linn.*, *Willd.*, *Spreng.*, *Smith*, *Hooker*, *Ehrh.*, *Huds.*, *Lightf.*, *With.*, *Pursh*, *Gray*.—*Lepidotis annotina*, *Beauv.*

FIG.—*E. B.* 1727.—*Flo. Dan.* 127.—*Dill. Musc.* 63, f. 9.—*Schk. fil.* 162.

DES.—Root of stout fibres on the forks of the stem. Stem very long and trailing, dichotomously branched, of a dullish-green colour, and extending in length from year to year. Branches simple or nearly so when fruitful, upright at first, afterwards becoming decumbent. Leaves, in five rows, lanceolate, acute, spreading, entire, or very slightly serrated. Fertile spike solitary, sessile, terminal, an inch long, scales very short, very broad, pointed and imbricated.

Sir J. E. Smith says, that “the scales of the spike of one season falling off, the stem thus left naked gives rise the following season to leaves, but these not being so numerous as in the other parts of the plant, the stem acquires an interrupted habit.” I cannot reconcile this to the appearance of my specimens, but rather suppose that as in the former species the spike wholly falls off, and the next year's shoot puts forth more vigorous leaves than those which terminated the old stem, thus giving the jointed appearance which the plant presents; but I have never seen it in a fresh state, and therefore write this with hesitation.

SIT.—On the highest Welsh and Scottish mountains.

HAB.—Pretty frequent between 500 and 850 yards on the mountains of Clova, and in the W. of Aberdeenshire; I have never seen it above 900 or below 400 yards; Glen Dole, Forfar, and mountains adjacent; Ben-na-Bour, Loch-na-Garr, &c. Aberdeen, *Mr. H. C. Watson*. Freewater, Ross-shire, *Mr. Stapes*. Hoy Hill, Orkney, *Rev. C. Clouston*. Summit of Cairngorum, *Sir W. J. Hooker*. Still found on Glyder Vawr, Snowdon, but reduced to a solitary root, and when last seen (1836), without fructification, *Mr. W. Wilson*. Charnwood Forest, Leicestershire, *Rev. A. Bloxam*. This is remarkable as being the only English habitat recorded. (See ‘Naturalist,’ vol. ii, page 135.) Not in *Mr. Mackay's* ‘Flora Hibernica.’

GEO.—Europe, in mountainous countries; in America, from Canada to Pennsylvania; also in North Asia.

3.—LYCOPODIUM INUNDATUM.

MARSH CLUB-MOSS.

(Plate V, fig. 3.)

CHA.—Stem creeping. Branches simple, erect. Leaves and scales linear, acute, curved upwards. Spikes solitary.

SYN.—*Lycopodium inundatum* of botanists.—*Plananthus inundatus*, Beauv.

FIG.—*E. B.* 239.—*Flo. Dan.* 336.—*Dillen Mus.* 62, f. 7 (*good*).

DES.—Stem very closely appressed to the ground, 1 to 2 inches long, and but slightly branched, bearing fibrous roots all along its lower surface. Branches simple, barren ones decumbent, fertile ones upright. Leaves irregularly placed, crowded, linear lanceolate, acute, all turned upwards. Spikes solitary, terminal, green, 1 inch long, quite erect. Scales linear, dilated at the base, curved upwards, entire or with one or two teeth only in luxuriant specimens.

This plant, which, like the rest of its tribe, is perennial, shows very strikingly the manner of growth of all the creeping species, though there are few of them so rapid in their decay as this. It creeps along the ground, and grows at one end as it decays at the other; thus if its habitat be a level piece of mud, as it generally is on commons, &c., the effect is easily seen in a black mark or line of the decayed plant, sometimes for many inches beyond where it is then vegetating. It ceases to grow in the winter, but continues to decay; thus very many plants are exterminated, and only the vigorous ones have strength to put forth new foliage; of these a very small portion generally remains, and thus it is that the plants are always small in the early part of the season.

SIT.—On wet moors and commons, particularly where turf has been pared.

HAB.—Near Loeh Lee, Nairnshire, *Mr. W. Stables*. Near Craig Darrock, Ross-shire, *Rev. G. Gordon*. Delamere Forest, Bartington Heath; and Baguley Moor, Cheshire, *Mr. W. Wilson*. Coleshill, Warwickshire, *Rev. W. Bree*. Valley near Cæsar's Camp, Wimbledon Common, Surrey; bogs near Titchborne Church, Hants (1836); Putney Heath; Bagshot Heath; Shirley Common, Surrey; and Keston Heath, Kent, *Mr. W. Pamplin*. Esher Common and Cobham Common, Surrey, *Mr. R. Castle*. Filby, Belton, Yarmouth, Norfolk, *Mr. Paget*. Sussex and South Kent, *Rev. G. E. Smith*. Bovey Heathfield, Devon, *Mr. Babington*. Not in Ireland.

GEO.—Europe, Isle of Bourbon (?), Canada to New York.

4.—LYCOPODIUM SELAGINOIDES.

PRICKLY CLUB-MOSS. MOUNTAIN-MOSS.

(Plate V, fig. 4.)

CHA.—Stems procumbent. Leaves lanceolate, acute. Spikes large, solitary. Scales ovate, deeply toothed, the lower with large, the upper with small spores.

SYN.—*Selaginella spinosa*, *Beauv.*—*Lycopodium selaginoides* of *modern authors*.
—*Bernhardia spinosa*, *Gray*.

FIG.—*E. B.* 1148.—*Flo. Dan.* 70.—*Ditt. Mus.* 68, *f.* 1.—*Schk. flit.* 165.

DES.—Stems creeping, slightly branched, 2 or 3 inches long. Barren branches delicate, recumbent, simple. Fertile branches upright, rigid, bearing a solitary spike. Leaves lanceolate, acute, toothed, imbricated, bright green. Spikes large, oblong, cylindrical yellowish, and terminal. Scales much larger and wider than the leaves, and deeply toothed, spreading widely on account of the very large capsules.

This species shows very well the two sorts of capsules mentioned in the Introduction, and should really be separated generically from the rest, under the name of *Selaginella spinosa*, *Beauvais*.

Mr. T. G. Rylands, alluding to some specimens gathered on Seaforth Common, near Liverpool, says truly, "that plants of this species are of a brighter colour than the rest, and that when growing they appear to form small thick tufts about an inch in height and diameter."

SIT.—On mountain sides, and in moist alpine situations.

HAB.—Hoy Hill, Orkney, *Rev. C. Clouston*. Ben Lawers, *Mr. H. C. Cooper*. Ben Lomond, *Mr. W. Leighton*. North coast of Sutherland, at the sea level, *Dr. Johnston*. Rare in Aberdeenshire, *Dr. Murray*. Moray and Ross-shire, *Rev. G. Gordon*. Abundant in the Highlands, rising to situations of 1000 yards or more in height, on the Breadalbane mountains, Perthshire. Pretty frequent on the hills of Cumberland, as around Borrowdale, Keswick, Derwentwater, &c., *Mr. H. C. Watson*. Near Richmond, Yorkshire, *Mr. J. Ward*. In wet places among sand-hills on the coast of Anglesea, near Aberffraw, and on the coast of Lancashire, near Southport, *Mr. W. Wilson*. Higher parts of the Tees, *Mr. J. Hogg*. Caernarvonshire, *Mr. J. E. Bowman*. Wyn-ddur, Arddu, Snowdon, *Mr. C. Babington*. Capel Curig, *Dr. Howitt*. Llanberis Pass and Nant Phranean, *Mr. Watson*. Various parts of Ireland, *Mr. H. C. Mackay*.

GEO.—Sprengel says, only found in Europe at Bremen, Oldenburgh, Silesia, Bavaria, and Switzerland. In Canada and New Hampshire, in America, according to Pursh, who says the American is smaller than the English plant.

5.—LYCOPODIUM ALPINUM.

SAVINE-LEAVED CLUB-MOSS.

(Plate VIII, fig. 5.)

CHA.—Stem procumbent, branches fascicled, flat at top. Leaves and scales in four rows.

SYN.—*Lycopodium alpinum* of almost all botanists.—*Lycopodium sabinæ-folium*, *Pursh*.—*Lepidotis alpina*, *Beauv.*

FIG.—*E. B.* 234.—*Flo. Dan.* 79.—*Dill. Mus.* 58, *f.* 2.

DES.—Roots long, with stout, branched, downy fibres. Stem 2 to 4 feet in length, creeping quite close to the ground, very rigid, irregularly leafy. Branches alternate, set along the stem at uncertain intervals, in an upright, rigid, close or fan-shaped fascicle,

level at the top. Leaves acute, oblong, imbricated in four rows, rather convex. Spikes terminating all the older branches, erect, an inch or less in length, and compact. Scales pointed, broad at the base, tapering upwards, with waved edges, sometimes with two or three teeth, flatter and less rigid than the leaves.

VIR.—According to Sir W. J. Hooker, it is used to dye woollen cloths of a yellow colour.

SIT.—On the grassy sides of mountains.

HAB.—At 1000 yards of elevation on Carnedd David, Caernarvonshire, probably 1200 yards in Aberdeenshire; also to the summit of Ben Hope, in Sutherland, at 1000 yards or thereabouts, where the climate is probably less genial than at 1200 yards in Aberdeenshire; to 1150 yards on Ben Nevis, and descending to the base of the mountains. Too plentiful on all the mountain tracts of Scotland to call for particular localities. On most of the Cumberland and Yorkshire mountains, *Mr. H. C. Watson*. Somerset, *Mr. A. Southby*. Near Todmorden, Lancashire, at a very low elevation (a single root only), *Mr. W. Wilson*.—IRE.: Aghla and Barnesmore mountains, Donegal, *Mr. E. Murphy*. Barnesmoor Mountain, and Mourne Mountain, *Mr. Mackay*. Brandon Mountain, *Mr. W. Wilson*.

GEO.—All the northern and mountainous part of Europe, as Lapland, Germany, Switzerland, Pyrenees, the Tyrol, Sweden, Norway, Russia, &c. Also in Canada and Siberia.

6.—LYCOPODIUM SELAGO.

FIR CLUB-MOSS. UPRIGHT FIR-MOSS.

(Plate VIII, fig. 6.)

CHA.—Stem erect, dichotomously branched, flat at top. Leaves in eight rows. Thecae axillary.

SYN.—*Plananthus selago*, *Beauv.*—*Selago vulgaris*, *Dilhe.*—*Lycopodium abietiforme*, *Gray.*—*Lycopodium Selago of other botanists.*

FIG.—*E. B.* 233.—*Flo. Dan.* 104.—*Dill. Mus. t.* 56, *f.* 1.

DES.—Root tufted, fibrous. Stems 2 to 6 inches high, growing quite erect, one issuing only from the root, and this becoming divided dichotomously until they form a cluster of from six to ten ultimate divisions; the upper fruitful branches are, however, scarcely more than forked. Leaves in eight rows, of a dark, shining green colour, crowded, lanceolate, entire, acute, convex on the outer side, a little spreading and curved upwards. The fruit is not borne in a terminal spike, as in the other species, but in the axils of the common leaves, all down the upper part of the stem. Capsules large, kidney-shaped, regularly two-valved, opening by a transverse fissure, and scattering minute, yellow, globular, smooth spores.

This plant is likewise viviparous, producing not only capsules of seeds, but occasionally also enrious petioled buds, which consist of three or four differently-sized ovate leaves; they are irregularly placed in the axils of the common leaves, that is, in the place of the capsules.

SIT.—On mountain sides, &c.

HAB.—It attains the summit of Ben-na-Muich-dhu, the loftiest of the northern Grampians or Cairngorum range, and the second summit of Britain (4320 feet). Common everywhere on the hilly tracts of Britain, especially the Scottish Highlands.—ENG.: Helvellyn, Skiddaw, &c.; on the loftiest rocks of Dartmoor, and above Edale Chapel, Derbyshire, *Mr. H. C. Watson*. Common about Settle, *Mr. J. Tatham*. Coleshill, Warwickshire (rare), *Rev. W. Bree*. Wensley Dale, Yorkshire, *Mr. J. Ward*. Once seen on Woolston Moss, near Warrington, *Mr. Wilson*. Waldron Down, Sussex, and near Bristol, *Miss Worsley*. Shotover Hill, Oxon, *Mr. Baxter*. Mansfield Forest, near the Blidworth Gate, *Mr. T. H. Cooper*.—WALES: Frequent on the Welsh mountains, where a variety is found with the leaves widely spreading, *Mr. W. Wilson*.—IRE.: Lough Bray and mountains in the south of Ireland (frequent), *Irish Flora*. Known in Kerry as Virgin Mary's Furze.

GEO.—Over Europe and North America. (Not in Pursh.)

EQUISETUM, Linn. HORSE-TAIL.



A, spike of fruit of *Equisetum patustre*. B, portion of the stem and branches of ditto. C, receptacle magnified. D, under side of a scale of ditto, showing the scattering of the spores. E, spore in its young state. F, ditto more advanced, and unfolding its filiform appendages. G, ditto spread out. I, transverse section of the stem of *Equisetum variegatum*. J, ditto of *Equisetum fluviatile*. K, longitudinal section of ditto. L, sheath of *Equisetum Drummondii*. M, longitudinal section of stem of *Equisetum limosum*. N, deposit of silex on *Equisetum Drummondii*.

A widely distributed but not very extensive genus, which inhabits for the most part temperate and cold countries. The species now living are all small plants, but the fossil remains of the Equisetaceæ show that at some former period gigantic specimens must have been frequent. Our plants prefer watery situations and strong soil. They may be divided into sections as follows:—

- * Fertile stems naked, succeeded by branched barren ones.
- ** Fertile stems branched from their first growth.
- *** Fertile stems not branched at first, but finally becoming so.
- **** Fertile stems always remaining simple or but slightly branched, barren stems the same.

Equisetum fluviatile, *Drummondii*, and *arvense*, belong to the first section; *E. sylvaticum* to the second; *E. patustre* and *limosum* to the third; *E. variegatum* *hyemale* and *Mackaii* to the fourth.

1.—EQUISETUM FLUVIATILE.

GREAT HORSE-TAIL. WATER HORSE-TAIL.

(Plate IX, fig. 1.)

CHA.—Barren stems erect, with thirty to forty branches in each whorl. Fertile stems short with loose sheaths, having numerous 2-ribbed teeth.

SYN.—*Equisetum fluviale*, Linn., Willd., Smith, Hook., Bolt., Huds., Lightf., With., Gray.—*E. telmateia*, Bab., Ehrh., Flo. Dan.—*E. eburneum*, Roth., Schr.—*E. majus*, Ray, Ger.—*E. maximum*, Lam.

FIG.—*E. B.* 2022.—*Bolt.* 36, 37.—*Ger. Her.* 1113.—*Flo. Dan.* 1469.

DES.—Barren stem 2 to 4 feet high, with about 30 grooves, quite erect, whitish, succulent, surrounded by whorls of from thirty to forty branches. Branches rapidly growing upon the stem as soon as it issues from the ground, giving it soon a broad-topped appearance. In its subsequent growth this blunt character is lost, the main stem becoming elongated, and the branches are then long, slender, simple, jointed, ascending, with channels along their surface, and at the angles of these other very minute ones. Fertile stems 4 to 6 inches high, arising in March or April, and decaying as the barren stems arise, reddish-white, extremely succulent, and wholly without branches at any time. Their sheaths, four to six in number, are nearly an inch long, and generally so close together as to overlap each other, very deeply, sharply, and numerous toothed. Catkin large and conical.

Withering says, "fertile stems sometimes leafy." He ought rather to have said, barren stems sometimes fruitful; as a catkin is often found in the middle or latter part of summer terminating it, particularly if the weather has been dry for some time previously; in fact it may be produced at any time with such cultivated plants as grow in pots, merely by removing the pots from the watery situation in which they are usually placed into a drier spot of ground. Mr. W. Wilson attributes this state of the plant to drought, as here stated, and adds that he has seen a specimen gathered near Bangor where this catkin was topped by a prolongation of the branched frond (July 1836).

The name fluviale is not so applicable to this species as it would have been to some others; it is rarely found on the banks of rivers or ponds, nor do I remember ever having seen it growing in the water. It rather affects strong, loamy, damp ground, clayey banks, and swampy bogs.

HAB.—Very abundant in some parts of England, as about London, in Hants, Bucks, &c.; but Mr. Watson thinks scarcely a common plant generally.

GEO.—Europe, Siberia, North America.

2.—EQUISETUM DRUMMONDII.

BLUNT-TOPPED HORSE-TAIL.

(Plate IX, fig. 2.)

CHA.—Barren stem blunt, erect, with about twelve branches. Fertile stems with adpressed sheaths with 1-ribbed teeth.

SYN.—*Equisetum Drummondii*, Hook. in *E. B. Suppl.*; Mack., *Fl. Hib.*—*E. umbrosum*, Willd., Hook., and Arnott, *Bab.*

FIG.—*E. B. Suppl.*, t. 2777.

DES.—Barren stem exceedingly delicate, finely tapering upwards, with about 20 grooves, very rough on the angles, with white and shining particles of silex, 12 inches high, of a pale, lightish green, particularly the sheaths, which widen upwards, six or eight in number, rather close together, with long, black, terminal teeth.

This plant differs from *Equisetum arvense* in its more glaucous green colour, very much more delicate habit both of stem and branches, and blunter outline. The fertile frond is much more rigid in texture, with harder, whiter, and more numerous-toothed sheaths, and the points of the teeth are more diaphanous than in the next species.

HAB.—First found by Mr. T. Drummond at Wolf Hill, the seat of W. Thompson, Esq., near Belfast.

3.—EQUISETUM ARVENSE.

CORN HORSE-TAIL.

(Plate IX, fig. 3.)

CHA.—Barren stem taper-pointed, decumbent. Sheaths of the fertile stem three or four, distant, loose.

SYN.—*Equisetum arvense*, Linn., Willd., Smith, Hook., Bolt., Ehrh., Huds., Lightf., With., Pursh, Mack., Gray.—*Equisetum segetale*, Ger.

FIG.—*E. B.* 2020.—*Bolt.* 34.—*Flo. Lon.* 64.—*Ger. Her.* 1114.—*Park.* 1202.

DES.—Main stem of the barren frond with few grooves, procumbent, tapering to the end, sometimes very long, pointed, rough, with whorls of branches all the way down, and forked at the base; that is to say, two or more stems springing from the same part of the rootstock. Branches simple, varying much in number, fourteen or sixteen, if all are present, but generally not more than eight or ten, or even six, at the upper part of the stem. They are dark green, rough, four channeled, with simple angles. Fertile fronds appearing before the others, light brown, with four or five distant, deeply-toothed sheaths. The teeth are sharp, ribbed, and rather dark coloured, particularly round their edges. As the fertile frond comes to maturity, the sheaths decay from the point downwards; thus

their black tooth is often tipped with white, and surrounded with a diaphanous membrane, particularly the upper sheaths, which are larger and longer than those below.

The plant puts on very different characters in different circumstances; sometimes it appears as a cylindrical pointed stem, without any branches; this is its early state, for it does not throw out branches immediately, like *Equisetum fluviatile*, therefore it never appears with a densely leafy, obtuse frond as that does. On strong soil, and in shady situations, as when hid among growing corn, the branches become exceedingly long, scattered in habit, and often geniculated, in which state it is represented by Gerard as *Equisetum segetale*. The closeness and number of the sheaths of the fertile stem are by no means a sure diagnostic of any of our species; the remarks respecting them, therefore, are more general than specific information.

SIT. and HAB.—In corn-fields, sandy banks, waste ground, &c. This species is so common, and so difficult to eradicate, as to be a very troublesome weed.

GEO.—Found equally in Europe, Asia, and North America.

4.—EQUISETUM SYLVATICUM.

WOOD HORSE-TAIL.

(Plate IX, fig. 4.)

CHA.—Stem erect. Branches compound, deflexed. Sheaths loose, ending in 3 or 4 blunt teeth.

SYN.—*Equisetum sylvaticum* of all modern botanists.

FIG.—*E. B.* 1874.—*Bolt.* 32, 33.—*Flo. Dan.* 1182.—*Schk. fl.* 166.

DES.—Stem erect, with about 12 grooves, from 6 inches to 2 feet high, branched, bright green. Branches compound, slender, smooth, drooping at the ends, and whorled, the lower part of the stem without branches. Catkins ovate, erect, stalked, and terminating the stem, borne early in the season, and dying away long before the remaining part, as is the case with all the following species; it is very rarely, however, found in fruit. Sheaths deeper coloured than the stem.

SIT.—In woods and shady places, chiefly in the North.

HAB.—Ross-shire and Moray, *Rev. G. Gordon*. Orkney, *Rev. C. Clouston*. Frequent in the Highlands of Scotland, *Mr. W. Wilson*. Near Richmond, Yorkshire, *Mr. Ward*. About Settle, Yorkshire (scarce), *Mr. J. Tatham*. Near Leeds, *Mr. Denny*. Forge Valley, near Scarborough, Yorkshire; near the ruins of Dale Abbey, and Southwood, near Calke Abbey, Derbyshire, *Rev. A. Blouam*. Egerton, near Bolton, *Mr. W. Christy*. Cumberland, Cheshire, Lancashire, *Mr. Watson*. Benthal Edge, Salop, *Mr. W. Leighton*. Cromford Moor, Derbyshire, *Dr. Howitt*. In Bagley Wood, between Oxford and Abingdon, *Mr. W. Baxter*. Hampstead Heath and fields towards Hendon, Middlesex, *Mr. W. Pamplin*. Sussex, *Rev. G. E. Smith*. Somerset, *Mr. Southby*. Moist woods, Kelly's Glen, Ballynascorney, *Mr. O. Kelly*. Abundant in the North of Ireland, *Mr. Mackay*.

GEO.—All Germany, Prussia, Holland, and Switzerland. From New York to Virginia, &c., and in North Asia.

5.—EQUISETUM LIMOSUM.

SMOOTH NAKED HORSE-TAIL.

(Plate IX, fig. 5.)

CHA.—Stem erect, naked or branched, smooth. Sheaths short, appressed. Teeth numerous, short, acute and rigid.

SYN.—*Equisetum limosum*, *Lin.*, *Willd.*, *Smith*, *Hook.*, *Bolt.*, *Huds.*, *Lightf.*, *With.*, *Mack.*, *Gray.* — *Equisetum polymorphum*, *Schr.* — *Equisetum heleocharis*, *Ehrh.*

FIG.—*E. B.* 929.—*Flo. Dan.* 1184.—*Bolt.* 38.

DES.—Stem erect, quite smooth, striated with many slight furrows, but not channeled, generally naked, but *sometimes* putting out a few branches late in the season, which are smooth, simple, and ascending. Catkin terminal, broad and short, for the most part sessile in the upper sheath. Sheaths short, close pressed to the stem, with very numerous short brown teeth.

Often confounded with *Equisetum palustre*, of which by some of the older botanists it was considered only a variety. It is, however, very distinct, and may easily be distinguished by not bearing branches till late in the season, after the catkin has decayed; its branches also are less numerous, shorter, and either scattered over the plant or in irregular whorls; it has shorter and more numerously-toothed sheaths, which are pressed close to the stem. The whole plant is smoother, and has shorter, thicker, and nearly sessile catkins.

SIT.—In low swampy ground, sides of streams, &c.

HAB.—Not so common as *Equisetum palustre*, but pretty generally distributed. Moray and Ross-shire, *Rev. G. Gordon*. Tees, *Mr. J. Hogg*. Cheshire, Lancashire, and Cumberland, *Mr. H. C. Watson*. Wensley Dale, Yorkshire, *Mr. J. Ward*. Needwood Forest, Staffordshire, and Gamlingay Bogs, Cambridgeshire, River Severn, near Shewsbury, Hancott Pool, ditto, *Mr. W. Leighton*. Near Wrexham, *Mr. J. E. Bowman*. Warwickshire, *Rev. W. Bree*. Leicestershire, *Rev. A. Bloxam*. Derbyshire, *Dr. Howitt*. Norfolk, *Miss Bell*. Somerset, *Mr. Southby*. Sussex and South Kent, *Rev. G. E. Smith*. Near Bristol, *Miss Worsley*. Frequent in Ireland, *Mr. Mackay*.

GEO.—Holland, Switzerland, and other parts of Europe.

6.—EQUISETUM PALUSTRE.

MARSH HORSE-TAIL.

(Plate IX, fig. 6.)

CHA.—Stem erect, naked or branched, rough. Sheaths long, loose. Teeth few and long.

SYN.—*Equisetum palustre* of all English botanists.—*Equisetum nodosum*, *Schr.*—*Equisetum ramosum*, *Schl.*

FIG.—*E. B.* 2021.—*Bolt.* 35.—*Flo. Dan.* 1183.—*Lob. Icon.* 795.—*Ger. Her.* 1114.—*Schk.* 168, 169.

DES.—Stem upright, branched throughout, 6 to 12 inches high, dark green, deeply channeled with 6 or 8 grooves. Branches five-sided, simple, ascending, six to ten in a whorl, a less number of and shorter branches upwards. Catkins terminal, cylindrical, tapering, on a long stalk, erect; found in May and June, sometimes before the branches, at other times appearing long after the stem becomes branched. Sheaths large, loose, with a few long tapering black teeth.

β (*alpinum*), smaller, upper branches abortive.

γ (*polystachion*), upper branches elongated and fruitful.

The second variety is always found in such situations as convince us that its peculiar conformation arises from its being nipped by frost or eroded by cattle, especially as when thus proliferous, the main stem is almost always injured at the top; a proof that here, as often is the case with Flowering Plants, the early shoots being by any cause destroyed, the plant makes an effort to repair the loss at a later season of the year by producing others.

SIT. and HAB.—Very common in ponds, wet valleys, water-courses, &c. — β : Breadalbane Mountain, Perthshire, at 3000 feet high, *Mr. H. C. Watson*. — γ : No certain habitat of this can be given, because it is an accidental state of the plant, and not a permanent variety. I have often found it in Richmond Park, Surrey, and by the side of the Lea River at Stratford, Essex.

GEO.—Common throughout Europe, and in North America.

7.—EQUISETUM VARIEGATUM.

VARIEGATED ROUGH HORSE-TAIL.

(Plate IX, fig. 7.)

CHA.—Stem procumbent, rough, 1 with 4—10 grooves. Sheaths black at top. Teeth few, white, and persistent.

SYN.—*Equisetum variegatum*, *Willd.*, *Schk.*, *Smith*, *Hook.*, *Mack.*—*Equisetum arenarium*, *of authors.*—*Equisetum tenne*, *Hopp.*

FIG.—*E. B.* 1987.

DES.—Rootstock very woolly. Stem branched at the base only, rather procumbent in habit, 4 to 12 inches high, of a green colour, rough and channeled. Catkins terminal, ovate, at first black and sessile, afterwards long-stalked, yellow and brown. Sheaths of the stem widening at top, green below, black only at their upper part, which is sharply, but not numerously toothed, the upper sheath of the stem being much larger and more spreading than the rest.

Its smaller size, recumbent habit, differently-coloured sheaths, with their prominent and permanent teeth, serve to distinguish this from *E. hyemale*.

SIT.—On the sandy sea-shore in the north of the kingdom.

HAB.—ENG.: Sand-hills on the Cheshire coast, between Hoylake and the Rock Fort, *Mr. H. C. Watson*. Wardrew, Northumberland (abundant), *Mr. Winch*. Southport, Lanc., *Mr. W. Wilson*. Near the Powder Magazine, in Wallasey, opposite Liverpool, *Mr. J. E. Bowman*. Bootle Sands, near Liverpool, *Mr. Rylands*. Near Winch Bridge, Teesdale, *Mr. Bowman*.—SCOT.: Sands of Barry, Forfarshire, *Dr. Greville*. Near Avoch, Ross-shire, *Rev. G. Gordon*.—IRE.: Portmarnock, opposite Baldoyle, *Dr. Taylor*. Mucruss, Killarney (a tall var.), *Mr. W. Wilson*. Moist banks near a waterfall at the upper end of Colin Glen, Belfast, *Mr. Mackay*. Ballyharrigan Glen, near Dingiven, *Mr. D. Moore*.

GEO.—Switzerland, Italy, France, Alsatia, &c.

EQUISETUM MACKAIL.

LONG-STEMMED HORSE-TAIL.

(Suppl. Plate, fig. 6.)

CHA.—Stem simple or very slightly branched, very rough, with 8—12 grooves. Sheaths appressed, finally black all over, teeth slender, persistent.

SYN.—*Equisetum elongatum*, *Hook.*, *Br. Fl.*, 5 ed.

FIG.—*Newman*, *British Ferns*, 2d ed. p. 15. *Phytologist*.

DES.—Stem 1 to 3 feet high, simple or with solitary distant branches. Catkins with a point. Sheaths cylindrical, at first pale green with a black band below the teeth, finally all black.

HAB.—Mountain Glens, near Belfast, *F. Whittle, Esq.*, and *Dr. Mackay*. North of Ireland. River Dee, Scotland.

GEO.—The synonymy of this species not being quite settled, its foreign distribution cannot be stated with certainty.

8.—EQUISETUM HYEMALE.

ROUGH HORSE-TAIL. SHAVE GRASS. DUTCH RUSH.

(Plate IX, fig. 8.)

CHA.—Stem erect, rough, deeply striated with 14—20 grooves. Sheaths short, appressed, white in the middle, black at each end. Teeth deciduous.

SYN.—*Equisetum hyemale*, *Linn.*, *Willd.*, *Smilh.*, *Hook.*, *Lightf.*, *Ehrh.*, *Huds.*, *With.*, *Pursh.*, *Mack.*, *Gray.* (Not of *Bory.*)—*Equisetum nudum*, *Ray.*, *Gerard.*

FIG.—*E. B.* 915.—*Hook. in Flo. Lon.* 161.—*Ger. Her.* 1113.—*Boll.* 39.—*Schk. fil.* 172.

DES.—Rootstock black, branched. Stems erect, of a very dark green, without whorls of branches, but forked and divided at the base, 2 to 3 feet high, regularly and numerous furrowed. Sheaths 2 to 3 inches distant from each other, very closely pressed to the stem, short, with a black rim at the top and bottom of each. Teeth of the scales black and deciduous.

It is surprising that this plant, so valuable in a general as well as a commercial

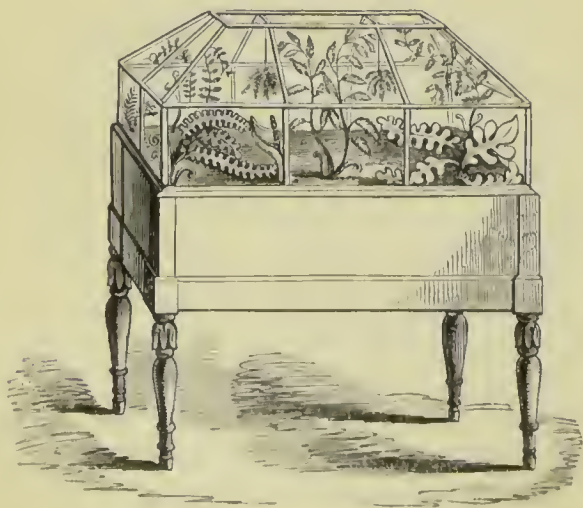
point of view, is not cultivated along our sandy coasts, where it would grow luxuriantly and rapidly, forming a strong embankment, and yielding a considerable profit. The Dutch are well acquainted with the value of its long and matted roots in restraining the wasting effects of the ocean, which would soon undermine their dykes were it not for the *Equisetum hyemale* which is planted upon them. At the proper season it is cut down and exported to other countries, where its naked and flinty stems are used for polishing domestic utensils, furniture, marble, &c. It is here sold as Dutch rush (not Dutch rushes, which are *Scirpus glaucus*, or sometimes *Scirpus palustris*; the former being used for the bottoms of chairs, the latter by coopers to stop leakages).

So abundant is the silex upon both the inner and outer surface of the stem, that the whole of its vegetable matter may be removed without destroying the shape of the plant. Every part of it is a very beautiful object under the microscope.

SIT.—In woods and boggy places; rather rare, particularly in the South.

HAB.—ENG.: Hawthorn Dean, Durham, *Mr. T. H. Cooper*. Scotswood Dean, near Newcastle, *Mr. Bowman*. Near Over, Cheshire, *Mr. W. Wilson*. Common near Halifax, *Mr. R. Leyland*. In a dell at Bitterley, below the Cleve Hills, Salop. Forge Valley, near Scarborough, Yorkshire. In a small stream at the bottom of Grace Dieu Wood, Charnwood Forest, Leicestershire, *Rev. A. Bloxam*. South Kent, *Rev. G. E. Smith*.—WALES: Near Wrexham, *Mr. J. E. Bowman*.—SCOT.: Edinburgh, in the stream just below Roslin Castle, *Mr. H. C. Watson*. Moray and Ross-shire, *Rev. G. Gordon*. Wood at Cora Linn, Lanarkshire, *Mr. C. C. Babington*.—IRE.: Tyrone, *Mr. Shutteworth*. Wood at Leixlip Castle, near Dublin. Powercourt, and around Dublin, *Mr. Mackay*.

GEO.—All Germany, Holland, and Switzerland. From Canada to Virginia, and in Asia.



APPENDIX.

CULTIVATION OF FERNS GENERALLY.

THIS tribe of plants was, but a few years ago, scarcely known in cultivation. Lately, however, it has been considerably sought after; and as little has hitherto been written on the culture of Ferns, or the selection of species, the following general observations will, I trust, be acceptable. It is right to observe, that for a great part of the list, and some of the remarks which follow, I am indebted to Mr. Bevis, of the Botanic Garden, Regent's Park, a well-known and ardent cultivator of the Ferns.

Sowing.—For sowing Fern-seed the spring of the year is to be preferred. The pots in which it is to be sown should be of a small size (say forty-eights), both for the sake of convenience, and because they hold less moisture, and allow a better circulation. Fill the pots half full of fine-broken potsherds; that is, garden pots broken into small pieces. Over these lay a portion of Sphagnum, or other porous moss; and then fill the pot to within half an inch of the top, with soil prepared in the following manner:—Take three parts of loose or unadhesive peat earth (that is to be chosen which lies about an inch beneath the surface, where it is not too much decayed); put it into a pan of boiling water to kill any vegetable matter that may be alive, or small worms, which become very troublesome as the Fern-seeds vegetate; then let it get dry enough to rub through the hand, but not very finely; to this powdered peat add one third of white sand, mixing both articles well together. When the pots are filled to within half an inch of the top, give them a little water, on which sow the seeds, taking care not to water them afterwards over the top. The seeds should be sown thinly—if thickly sown, or too much water be given, they are apt to *fog*, or kill each other, before they are large enough for potting or pricking off. After sowing, lay a piece of common glass over the top of the pot, and set it in a saucer, taking care not to let the saucer be without water, and place it in a light but shaded place. When the plants have shown the first leaf, a little air may be admitted—after which, should they be too thick, they may be thinned by taking them up in small patches with the point of a knife, and transplanting them into another pot, prepared as the former, but made fine by sifting the soil; when large enough they may be divided a second time. Many persons mix a great portion of broken brick in the seed pot, upon which the seeds vegetate well, but the difficulty of transplanting therefrom is very great. It is of course necessary to know whether the species belong to the greenhouse or stove, that the vegetating seed may be placed in a congenial climate, observing only that a dry air and direct sunshine are to be as much as possible avoided.

After-cultivation.—Ferns of different habit require a different treatment. This is in some degree accordant with their natural soil and places of growth, yet not wholly so. Many of the British Ferns, although they naturally live in bleak and exposed situations, yet when under culture require some degree of protection. So also, notwithstanding some of them seem naturally to prefer the

interstices of brick walls, such, for example, as *Grammitis Ceterach*, they will not flourish in brick rubbish. To treat this little-understood part of the subject intelligibly, and to show the extent to which the foregoing observation applies, it is advisable to divide the Ferns into various distinct sections, as follows:—

STOVE AND GREENHOUSE FERNS.

Ferns with rhizomas.—These in their native habitats are, in many instances, epiphytes, deriving their nourishment chiefly from the air, or from other scanty sources. If potted they require much less water than others, the soil should be porous, and the pots should be filled half full of turfy peat. Most of this division thrive very well suspended on blocks of wood, in a warm moist atmosphere, but should be watered very sparingly in the winter season. The small, creeping, entire-leaved species thrive as epiphytes, as they run a long way in the season. These are readily increased by cuttings. If potted they seldom show any fructification, owing to their stunted habit.

Ferns with crowns.—Those Ferns with crowns from which the fronds issue, require a soil made finer, with a greater depth. Care must be taken in not covering their crowns, which is certain death to the greater number of the species; they likewise require more frequent watering, as they are sooner affected by drought. Many of this section produce bulbs upon their leaves, from which they readily increase. Others root from the tip of their fronds, without forming bulbs; such is the case with many of the *Aspleniums*. This section requires care in dividing, as by this mode they seldom make good plants; it is preferable to increase them from seed, as they grow more freely, and make finer plants. The *Gymnogrammas* should be potted in loam, as they are very apt to damp if potted in peat soil; in fact, most Ferns which have various-coloured leaves prefer a loamy soil. No kind of manure should be at any time given to Ferns; even weak lime water should be avoided, as great havoc is sometimes made with it.

Ferns with thick fleshy roots.—Of these there are but a few species. All those of *Marattia* have a curious scaly cormus, resembling that of the genus *Zamia*, from which are produced strong, thick, fleshy roots. They prefer loam and peat, and are easily injured by shifting, as the soil is very apt to drop from them when they are turned out of the pot. If kept too hot they are apt to drop their leaves; they do best in a temperature not exceeding 60°. *Danaeas* resemble the last genus, and require the same treatment. Care must be taken to give them free draining.

Arborescent Ferns.—In general these do not thrive well; they require a very moist atmosphere. Their stems should always be bound with *Sphagnum*, or they soon look very sickly, as they are covered all up their stem with spongioles, by which they, in a great degree, receive their nourishment. They should be well drained, and freely syringed on their stems to keep the moss moist.

Numerous of the Ferns under stove culture are infested with a species of Thrips; others have a rusty appearance, often laid to that insect, but which appears to arise from being kept too warm—the greenhouse species, mixed with those properly belonging to the stove, being always first attacked. Other insects seldom attack them, with the exception of brown scale and slugs, which are soon destroyed. The best remedy for the Thrips is the vapour arising from sulphur sprinkled over the flues or pipes.

HARDY FERNS.

Hardy Ferns should always have a prepared soil on a sloping north bank, where they are seen to the greatest advantage. Some of the strong *Aspidiums* will grow in any common soil, where the small species would soon perish. They prefer a shady place, but do not like the drip of trees, nor stagnant water about them. The border or soil should be made of one fourth coarse grit or river sand, with three parts peat or bog earth, chopped well in pieces, but not sifted—this should be a foot deep. If a very damp place, the border should have a layer of broken brick below to drain it, if intended for the more choice species; for although *Osmundas*, *Aspidium Thelypteris*, and *Blechnum boreale*, will grow in the water, they thrive better a small distance off, and you gain the advantage of growing all the species in the same border. Some of the smaller species should be raised on mounds above the border to keep them drier; the best way is to place four or five stones edgewise, thereby forming a hollow in the centre, putting a little drainage in the bottom. Small species prefer shallow soil; they are likewise benefited by placing a bell-glass over them, to retain the humidity of the atmosphere. Many of them it is difficult to find situations suitable for, without covering both in summer and winter; such for instance as *Adiantum Capillus Veneris*; *Asplenium alternifolium*, *viride*, *Trichomanes septentrionale*, and *marinum*; *Hymenophyllum Wilsoni* and *Tunbridgense*; *Trichomanes brevisetum*; *Ceterach*, and many small foreign species; likewise the *Lycopodiums*, the hardy species of which may all be grown. *Hymenophyllums* and *Trichomanes* require but little soil; they thrive best fastened on a piece of porous stone, over which has been shaken a little sand. They should always be covered with a glass, and kept very moist and shaded, being inhabitants of wet dripping rocks. Many of the other small species grow in drier situations, even on sunny walls, but they are always finer in the shade; from such situations they are difficult to remove, owing to the roots penetrating the crevices of the wall or rock, and take a long time to get thoroughly established in a new situation. The *Botrychiums* are also removed with difficulty; they require a good drainage.

Fern Houses.—The plan adopted by Mr. Ward, of Wellclose square, London, is deserving of particular attention from many causes, independent of the cultivation of the Ferns. The principle established by this excellent and well-known botanist is, that a constant renewal of air is not necessary for the well-being of plants. Thus if a plant be inclosed in a glass case, watered, and then the case closed up air-tight, the moisture which evaporates having no means of flying off will be condensed on the sides of the case, and trickling down will moisten the plants a second time, only to be evaporated and condensed again and again each succeeding day. Also, the air which is necessarily included in the cases does not become unfit for the use of the plant. That these are established facts may be easily proved by planting a Fern or a Moss in a phial, well corking and sealing the phial, and suffering it to remain in this state for a length of time. This may appear curious rather than useful, and on so small a scale as that of a phial it really is so; but the same principle holds good to any convenient extent, and a glass jar of many gallons, or a box with a glass top of any moderate size, may be thus stored with numerous plants, and made to form a highly interesting parlour ornament, and that without the plants requiring the least care or attention,

except to remove decayed parts, or train up a too exuberant growth. Even were the discovery capable of no further extent, it would be most invaluable in the transport of plants from one country to another, preserving them from the vicissitude of season, from the effect of salt spray (so detrimental to most plants), and from the inattention of their temporary guardians. Indeed Mr. Ward's air-tight cases are now universally employed for the transit of living plants. We would advert, moreover, to the injurious effect of a contaminated atmosphere upon plants, and remind our city friends of their repeated disappointments in window culture, or of their abortive attempts to ruralise their back court-yard. Mr. Ward's plan ensures them success; it is only necessary to cover it with glass—to have but one door of ingress, and that seldom to be used—and to stock the covered space with any plants that can endure a shady situation (among which the Ferns stand pre-eminent), and they have at once a beautiful greenhouse. It may, perhaps, be but a glass closet attached to the outside of an ordinary window, or it may extend the width of the house—in either case success is certain. Those who are desirous of learning more upon the subject may consult a little work by Mr. Ward, entitled, 'Growing of Plants in Closed Cases,' and which is published by Mr. Van Voorst, Paternoster row.

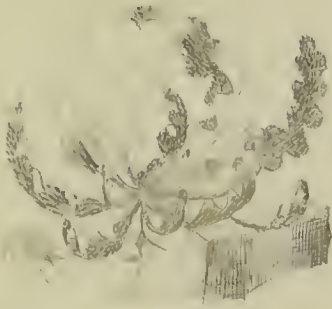
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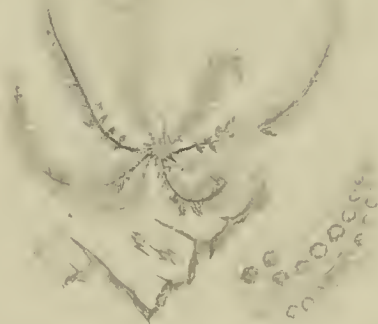
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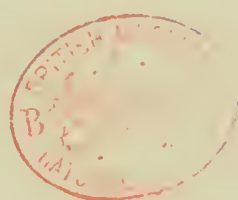


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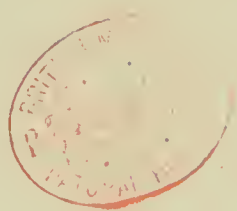


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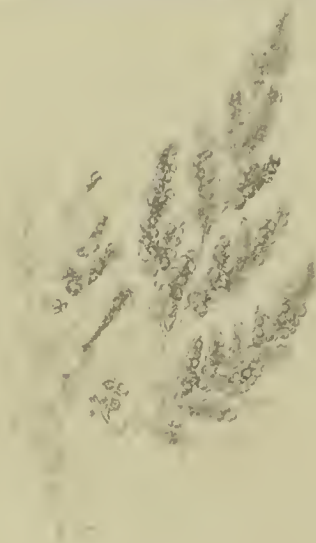


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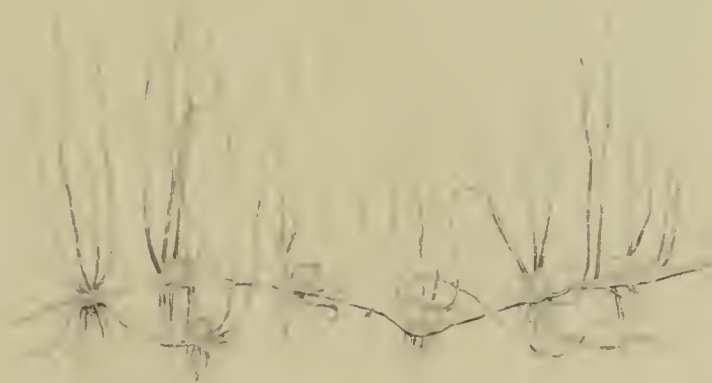
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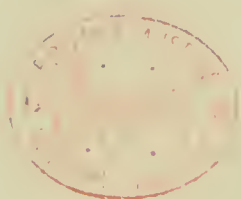


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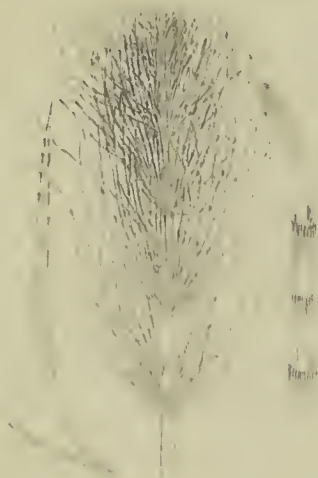


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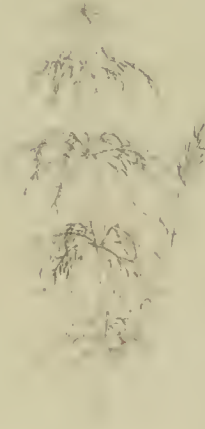
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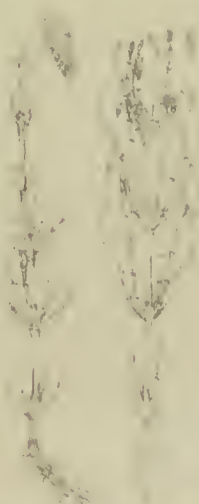
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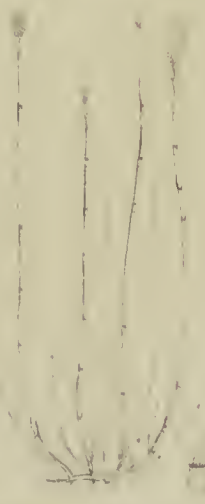
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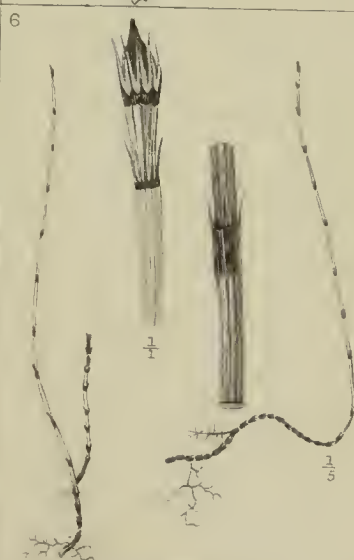


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E. G. Smith





